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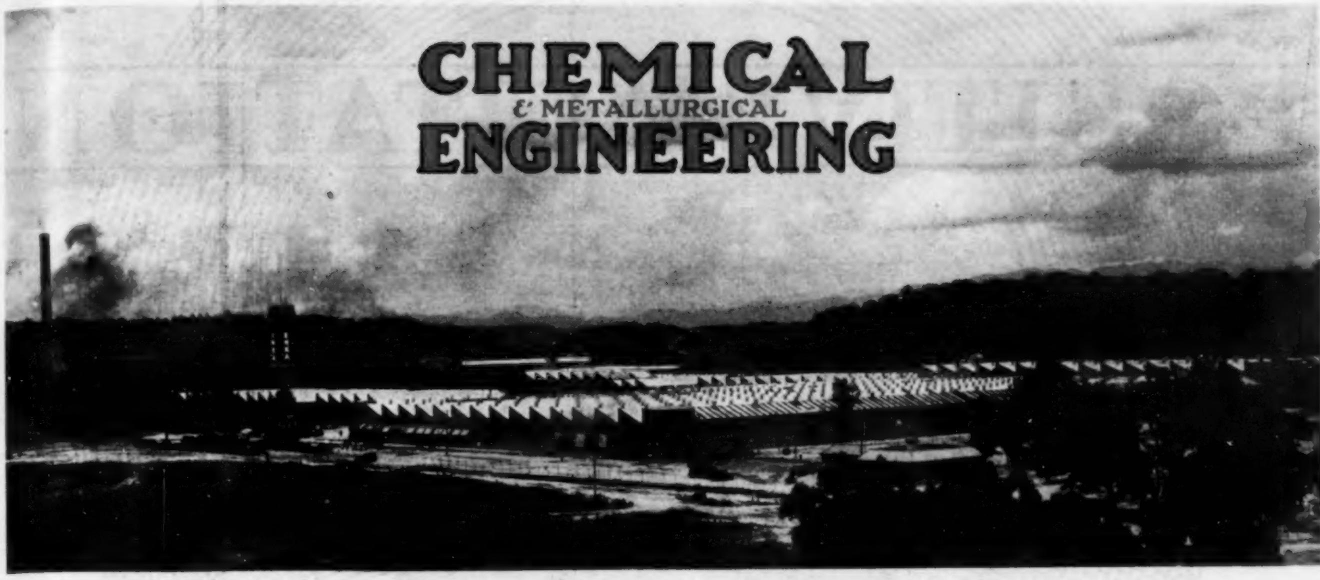

New Rayon Plant at Asheville, N. C., of the American Enka Corporation.

VOLUME THIRTY-SIX NUMBER ELEVEN

Contents for November, 1929

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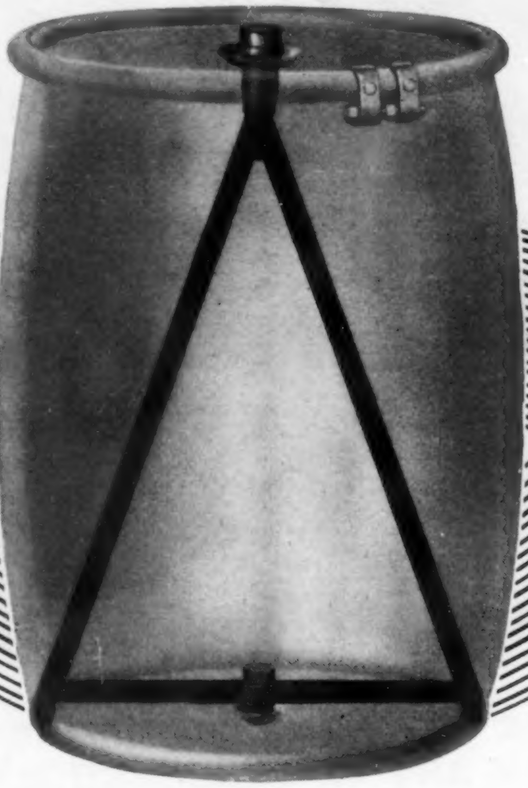

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CHEMICAL
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VOLUME THIRTY-SIX NOVEMBER, 1929 NUMBER ELEVEN
S. D. KIRKPATRICK, *Editor*

An Engineering Basis for Industrial Development

LATELY we have entered an era of inter-regional competition for new industries. Claims and counter-claims for advantages or disadvantages in climate, labor, power or transportation have contributed to what is becoming a Babel of confusing tongues. Yet out of this clashing of competing interests there are gradually emerging some sound principles of procedure. One formula that is being applied with notable success in certain parts of the country consists of three steps, viz.: Fundamental study of economic and industrial conditions, dispassionate analysis and appraisal of resources and, finally, a definite program of action based on established facts rather than on opinions or exaggerated claims. The method appeals particularly to the chemical engineer faced with the important task of locating a basic industry.

ONE OF THE MOST impressive of the regional programs is that undertaken by the New England Council, which has applied the principles of research to the serious problems presented in the oldest of our industrial areas. More recently, as the outgrowth of the State-wide Economic Congress, a committee of twenty-five of the business leaders of New York has undertaken a similar study of the reasons underlying the decline in manufacturing industry in New York State. Concerted action is promised for the first time in a thoroughgoing analysis of the whole situation, followed by the development and prompt carrying out of an adequate plan for the industrial future of New York.

SOUTHERN STATES have not lagged behind; in fact from the standpoint of purely promotional activity they have led the procession of industrial development. Outstanding enterprise has brought national recognition to the work of certain cities, notably Atlanta and Savannah, Charleston, W. Va.; New Orleans and Dallas. A few states, such as Virginia, North Carolina and Alabama, have organized larger units for commercial development. Power companies and the industrial departments of the railroads have done much to promote interest in Southern resources.

YET HERE, TOO, in the natural enthusiasm of this work there has been a duplication of effort and a confusion of claims that occasionally have resulted in ill-advised action. Although it is true that much of the remarkable growth of Southern industry represents permanent progress, it is also apparent that further development must be on the basis of a different program—a balanced plan for securing diversified, carefully selected industries.

THERE IS NOW an opportunity for the South to pool its interests in a co-ordinated program of industrial development. It has the physical resources that have already attracted many of the larger basic chemical industries which in turn will serve as the foundation for continued industrial growth. It has the human resources in business leaders whose individual ability and genius have created huge enterprises and thriving communities. The time has now come to fuse these forces for collective action. A master organization of all promotional agencies of the Southern States would have within its power the building of a great balanced economic structure which, because it would be planned on a sound engineering basis, might eventually eclipse any industrial civilization in the world.

Answering the Threats of Tariff Failure or Market Collapse

A CHEMICAL EXECUTIVE who spent several days in the Senate gallery this month listening to the vagaries of the tariff debate, returned to his business to marvel once more at the fundamental stability of a country that can withstand such evidence of misgovernment. Any disinterested observer—if such there be—who witnessed the recent stock market débâcle must likewise have marveled at the fundamental soundness of industry that continues to advance despite such gloomy forebodings. The truth of the matter is, of course, that both government and industry are founded on more substantial bases than coalition politics or the buying and selling activities of the speculator.

The Unbroken Trend of Chemical Profits

AT THE TIME when liquidation in the securities market was most severe, many companies in the chemical industry were issuing financial statements covering operations for the first nine months of this year. Net earnings of these companies are collated elsewhere in this issue and comparison given with the corresponding period of 1928. In every instance gains are recorded and the available data, covering a representative cross-section of the entire industry, demonstrate that the upward trend which has marked the earnings of chemical companies in recent years is still unbroken.

That the heavy wave of buying, speculative or otherwise, which continued over the last two years, carried some chemical securities to heights which too strongly discounted prospective earning power is undoubtedly true. That these securities had to fall in line when a general readjustment of values was in progress is equally apparent. A decline in security values, however, does not necessarily mean an impairment of earning capacity. For the first three-quarters of this year, the profits made by chemical manufacturers have been of a progressive nature. The position of consuming industries appears to be favorable for rounding out a highly successful year. Public confidence may be shaken to an extent which will have an immediate effect in the curtailment of purchasing power, but the danger of credit overextension has been removed and the freeing of funds for industry clears the way for the adoption of constructive policies. All this can scarcely fail to prove beneficial for all lines of industry.

Fraudulent Patent Practice Attacked in New Cramton Bill

FRAUDULENT PRACTICE in drafting and securing of patents has continued with more or less success, despite the greatest of vigilance on the part of federal officials. Even some who have been disbarred from practice before the Patent Office have found loopholes in the law by which they continue to escape punishment while securing profitable employment from unsuspecting individuals and corporations. A commendable effort to control these individuals by severe fines or actual imprisonment is proposed by the Commissioner of Patents, Thomas E. Robertson, which takes the form of a bill introduced by Representative Cramton as H.R. 699 of the present Congress.

Unfortunately, as originally drawn for the preceding Congress this bill involved certain restrictions that were objectionable to both chemists and engineers. In its original form it would have made such a technical man liable to both fine and imprisonment merely for acting as adviser in a professional capacity regarding any feature of the drafting or of the securing of patents. This effect, which was not at all desired by Commissioner Robertson, has been largely, if not wholly, remedied. The Commissioner's new draft of the bill for the present Congress, perhaps with some slight further revision which the Commissioner proposes to make, will be free from this objection and should pass.

Perhaps some technical men may feel that they are just as competent as lawyers in the handling of patent matters. As a matter of fact, such a feeling is fully justified and is shared by the Commissioner of Patents. These technical men, if they wish to indulge in patent practice, can do so under the new law if they will simply demonstrate their competence to become registered patent agents. Likewise, lawyers who may not be qualified by special training to practice before the Patent Office can still under this new law aid their clients in patent matters regarding which they are qualified to speak. In other words, the legitimate interests of scientist, technologist, and lawyer have all been safeguarded carefully. Only scoundrels need fear the teeth in the new law as the Commissioner proposes that it shall be formulated.

But they need to fear such law. There are enough of them abroad foisting their services on the public to necessitate drastic action. They hold themselves above and beyond the law, and for the present, it seems, are more or less correct in this view. Industry and the chemical engineering profession meanwhile will do well to support the legislation. And this can be done without in any way jeopardizing our own welfare, as some of the self-seeking gentry who wish to defeat the bill would have us believe.

Four Fruitful Years of Trade Practice Conferences

WITHIN the past month the Federal Trade Commission has announced its action on the rules of business practice that were adopted last June by the lime industry, through the agency of the National Lime Association. At a trade practice conference held in Washington under the auspices of the Commission, the Association voluntarily joined the growing list of industry groups which has dug down at the roots of its trade practice difficulties in conference with the Commission, and emerged with a code designed to eliminate those difficulties once and for all. *Chem. & Met.* has already taken cognizance of this healthy tendency toward industrial team work in self-regulation. Now on the eve of the publication by the National Industrial Conference Board of a new and revised analysis of the work of the Commission, it is fitting that these activities should be briefly reviewed where they touch upon the matter of trade practice.

It was in 1919 that the Commission inaugurated the procedure of co-operating with industry groups in eradicating trade abuses. The idea was slow of acceptance by industry and the first six years saw very few conferences. A few years later, however, Secretary of Commerce Hoover, in the famous correspondence on

trade associations with the Attorney General, clarified the co-operative situation so that fully 50 successful trade practice conferences have been held since 1925, of which 32 have taken place during the fiscal year ended June 30. Industries affected in the chemical engineering field have included: pyroxylin plastics, castile soap, insecticides and disinfectants, edible oils, petroleum products, glass, waxed paper and paper board, paint, varnish and lacquer, fertilizers, gypsum, face brick and lime. A solvents conference is to be held in the near future.

All this is very encouraging in the belief of the Conference Board. It is granted that this form of co-operation between government and industry is still in the experimental stage and that there are major issues yet to be solved. The industrial millennium is still around the corner. However, a very significant advance has been achieved in gaining the sympathy and confidence of the business world. We have only cracked the surface of the new co-operation.

A New Paper-Making Opportunity for the South

MANUFACTURE of bond papers from southern woods is indicated as an important possible development by the results of investigations of the Forest Products Laboratory, Madison, Wis. Hitherto the making of this grade of paper from southern pine has not been considered economically feasible, but a new combination of processes is shown to afford what appears to be a sound basis for this work.

The Laboratory has developed a modified sulphate process for use on southern pine to produce a very satisfactory pulp. Such a modified process gives a much lighter pulp than has hitherto been possible with the highly colored southern wood—surely a distinct achievement in itself. However, when a sulphite pulp made from southern gum woods, a product with a decidedly bluish white cast, is added to the sulphate pulp, the combination yields the color value and physical character sought for bond papers.

It is too early to predict what effect these discoveries may be expected to have on the Southern paper industry. Definite proof of the economic feasibility of the process must first be obtained. If its apparent usefulness is established the process will open an outlet for southern pulp which will give an excellent return on the work of the Forest Products Laboratory.

Let's Aid in Finding Stray Gas Cylinders

COMPRESSED GAS containers are expensive. When they go astray they are a loss to their owners and become useless in the service of the consuming industries. The Compressed Gas Manufacturers' Association is making a commendable effort to search out such strays and return them to their owners. User companies should co-operate in this movement. Those who have idle cylinders about their plant or empties the owner of which they do not know, should report such cylinders to the Association headquarters at 120 West 42d Street, New York City. The Association will do the rest, and the results will be beneficial to both producing and consuming branches of the business.

A New Crossroads of Chemical Commerce

IN LOUISIANA there is developing a new basis for a crossroads of industrial traffic, which promises to make this state an important factor in chemical manufacture. This development is based not alone on the availability in abundance of natural gas, petroleum, sulphur, and salt, but also on cotton, wood, naval stores, and other agricultural and forest products which can be grown upon the fertile soil of the lower Mississippi Valley at as low a cost as at any point in the United States.

The recent celebration of the completion of the nine-foot canal system of the Ohio River emphasizes the prospect of water transportation as a growing factor in American commerce. This internal waterway system meets at the lower Mississippi ports the constantly growing traffic of the Gulf of Mexico, which makes New Orleans next-door neighbor to the world. At this point there is a strategic center for the meeting of imported and domestic raw materials, for the processing of both, for the export of manufactured goods and chemical products, indeed a logical basis for a great chemical industry.

On previous occasions *Chem. & Met.* has called attention to the fact that the cotton-growing center of the United States is now at or west of the Mississippi River. This means that the greatest prospective market for fertilizers will lie in Louisiana or its sister states immediately adjoining to the north and west. The wood products industry, including paper and pulp and naval stores, is going to create other equally important chemical markets in this territory. The manufacturer of many chemicals must, therefore, consider this point as a manufacturing center in the not distant future. Although it has been the Southeastern area that has received the most attention in the past, the industrialization and development of the South in general are bound to bring about a corresponding development in the Southwest. It is quite possible that this expansion may overshadow that which will take place in the Southeast.

Plan to Go to Asheville

IF FOR NO OTHER REASON than to obtain a more intimate view of the present status of Southern industry, it would be worth your while to attend the Asheville meeting of the American Institute of Chemical Engineers, December 2 to 4. The men who have been responsible for this remarkable development, their plants and operating methods hold much of chemical engineering interest.

But if you are a member of the Institute you will want to participate in its discussion of organization policy and procedure. On no previous occasion have decisions been asked on more important Institute matters than those that will come before the business session at this convention.

Whether member or non-member, however, this December meeting holds peculiar attraction to chemical engineers at this time. Chemical industry is moving forward at a rapid pace in the South and this beautiful "Land of the Sky" seems to be destined for still further advance. A pleasant and profitable meeting is in prospect for those who can invest a few days in thus broadening perspective on chemical engineering industry and profession.

IN AN ADDRESS before the Institute of Public Affairs at Charlottesville, Va., on Aug. 10, 1929, Mr. Parmelee analyzed the economic factors responsible for this great development

What Underlies Chemical Industry's Growth IN SOUTHERN STATES

By H. C. Parmelee

Editorial Director, McGraw-Hill Publishing Company, Inc.
Secretary, American Institute of Chemical Engineers

INDUSTRIAL GROWTH and activity have characterized American life for the past generation and have eclipsed agriculture as the dominant factor in our welfare. The forces and phenomena of industry can be seen on every hand, and in some outstanding cases their incidence on society is apparent to even the casual observer. The automobile and the radio have changed our habits and customs, influenced our government and affected our national unity and cohesion. These things cannot escape our notice for they are on the surface.

There are, however, other industrial developments in the United States that lie beneath the surface of popular vision. They affect our welfare no less profoundly than those that are apparent. Indeed they may even be more important than the latter because they are basic and fundamental. They are the unseen foundations on which the visible superstructure of American industry is raised. Consequently they escape popular comprehension as great social, economic and political forces.

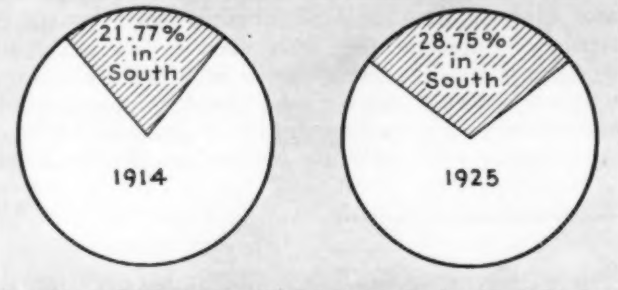
Chief among these is the chemical industry in all its aspects and ramifications. Its immediate products do not enter into popular consumption; but behind the scenes they flow into a great diversity of industries whose products touch our daily lives in great variety. Chemical industry is fundamental to agriculture, to the manufacture of pulp and paper, the refining of petroleum, the highest utilization of wood, coal and natural gas, the development of rubber compounds, the production of sugar, soap, paints, lacquers, ceramics, explosives, glass and leather. It has an incidence on our health, food, clothing and shelter and provides us with a host of commodities that characterize American civilization. Finally, it bears a direct relation to public welfare and national defense.

It is particularly pertinent to discuss the chemical industry, not only because it is basic to the development of Southern industry, but also because the South has many natural advantages that are encouraging a migration of chemical industry to that part of our country. In fact the South has already enjoyed in the past decade a larger share of the growth of American chemical industry than has come to any other section of the United States, and the future gives promise of logical development in this direction. Knowledge of these things should be spread abroad in the popular mind, not only because it gives a sense of pride in local achievement, but also because it helps to reveal one of the great forces that affect regional as well as national prosperity.

The logic of this development in the South is not far to seek nor difficult to find. Briefly it lies in the possession of natural resources in the form of basic raw materials and power, adequate transportation facilities and a good supply of labor. The raw material resources of the South I shall discuss later. As to power, we need only consider the network of interconnection of hydro-electric and steam-electric lines in the Southeast to realize how readily available is power to industry in that region. In the area covered by North and South Carolina, Georgia, Alabama and Tennessee there is developed a total of at least 6,000,000 hp., which in itself is a great lodestone to industry of all kinds.

History records significant efforts to utilize some of the available raw materials of the South, and to stimulate the production of chemicals essential to the

SOUTHERN CHEMICAL INDUSTRY IS GROWING FASTER THAN IS THE WHOLE INDUSTRY



Relation of Production by Southern States to all States

	Southern Production	U.S. Production	Per Cent
1914	$ 376,491,000	$ 1,728,883,000	21.77
1925	$1,612,585,000	$ 5,599,296,943	28.75

establishment of other industries. As early as 1608 attempts were made to manufacture tar, potash and glass in Virginia; and in 1620 iron, salt and leather were actually made in that region. Legislative steps were taken in 1707 to encourage the manufacture of saltpeter and potash in South Carolina; and the culture of indigo in that area in 1741 was the beginning of the natural dye industry in this country.

Significant of his wisdom and foresight is the fact that in 1802 Thomas Jefferson personally and officially encouraged the establishment of the explosives industry in the young Republic. E. I. du Pont de Nemours had come to this country in 1800 with technical knowledge of gunpowder manufacture in France; and it was through his friendship with President Jefferson that he was encouraged to establish the first powder mill on the banks of Brandywine Creek, near Wilmington, Del.

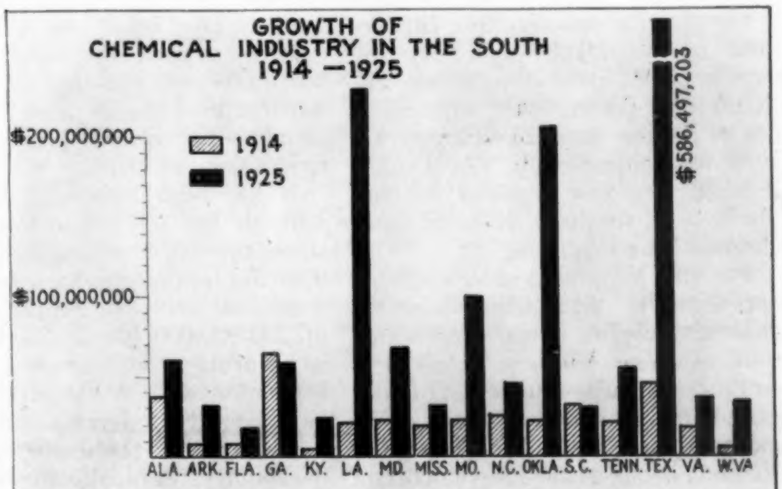
Fertilizer manufacture had its inception in Southern States. Deposits of phosphate rock were opened in South Carolina in 1867, and until 1888 furnished not only all the requirements of the United States for phosphate fertilizer, but also 90 per cent of the world's needs. Florida deposits were opened in 1888, and by 1894 the production exceeded that of South Carolina. Tennessee took a prominent place in phosphate rock production in 1893, and soon eclipsed South Carolina, which ceased this activity in 1922. A pioneer effort in nitrogen fixation, closely related to the fertilizer industry, was the erection and operation by the Duke interests of an arc furnace process at Great Falls, S. C.

These early historical incidents are mentioned only because they are significant of the part played by chemical industry even in a pioneer civilization. They show the recognition by a few intelligent and forceful minds of the value of raw materials and a few primitive chemical processes. But compared with recent developments in the South they are inconsequential and insignificant.

How long the chemical potentialities of the South would have lain dormant but for the emergent requirements of the World War is of course problematical. But it seems likely that this great national crisis focussed attention on Southern resources so sharply that chemical development received a great impetus. It was a time of stress. There was national and international searching for raw materials, power, labor and transportation to provide the requirements of a world under arms. In this emergency the South held the key to the solution of many problems, and it became the center of activity in chemical manufacture primarily for the production of war munitions. President Wilson established the nitrate plants at Muscle Shoals, Ala. Other tremendous developments went forward rapidly at Hopewell, Va.; Nitro, W. Va.; Old Hickory and Kingsport, Tenn., and altogether the South was a center of chemical manufacture.

That these developments should be followed by collapse at the close of the war was inevitable. Likewise it was impossible to escape a long period of prostration in the slow transition from war-time to peace-time activity. But even with these drawbacks the South had gained the advantage of concentrating national attention on its industrial possibilities, and soon chemical industry began to rebuild on the foundations that had been laid to meet a national crisis. Viewed after a period of ten years, the net result seems wholly favorable to the South.

GRAPHICAL presentation of the growth by states of the chemical industry in the South for the decade 1914-1925. The charts show the value in dollars of the production of certain chemical industries estabished in each State. With the exceptions of Georgia and South Carolina each Southern State shows a gratifying increase in value of production during the period under review. The slight decrease in both Georgia and South Carolina is due to a decline in the value of cottonseed products. Large increases and their principal causes are noted in Louisiana (with natural gas, pulp and paper and petroleum refining), Oklahoma (petroleum refining and cottonseed products), Texas (petroleum refining, paints, varnishes and cottonseed products). In its relation to the entire United States we find that the ratio of chemical production in the South was 21.77 per cent in 1914 and

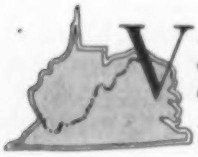


28.75 per cent in 1925, showing that Southern chemical industry increased during the decade more rapidly than did the industry as a whole. And when we consider the great developments that have taken place since 1925 it seems certain that the current decade will show even a higher ratio for Southern chemical industry.

But even with this gratifying growth there is other evidence that the South is not yet taking full advantage

of its opportunity for chemical manufacture. It is still primarily a consumer and not a producer of raw chemicals used in its industrial operations. For example, many of the States import from other sections of the country the chemicals required by the petroleum, sugar, textile, cottonseed and fertilizer industries.

Having previously considered from a statistical viewpoint the remarkable growth of the Southern chemical industries as a whole during the period since the war, it is of interest to view the status of the present development from certain focal points represented by six rather well-defined industrial areas. In the first I would put the States of Virginia and West Virginia—independent in a sense, yet supplementing each other in coal and many raw materials. The other areas in the order of my discussion are as follows: (2) The Piedmont area of the Carolinas; (3) Tennessee; (4) Georgia and Florida; (5) Alabama; (6) Louisiana, Mississippi and Arkansas.



VIRGINIA has been called the Mother of Industry on the American continent. Three hundred years ago many chemical industries had their beginning in this colony. Here, for example, were established the first salt plant, the first glass works, the first leather tannery, and the first baking powder plant. But now other "firsts" are to Virginia's credit. Rayon plants at Roanoke, Hopewell, Richmond, and Waynesboro have given the state first rank in this new industry. A synthetic ammonia and nitrate plant at Hopewell, already the largest in the country, is to be expanded according to a statement by its management until it will enable the United States to be independent of imported nitrogen for agriculture and the national defense. In the valley of Southwestern Virginia are to be found the largest salt and gypsum deposits south of the Ohio and east of the Mississippi. Utilizing this resource is the chemical industry that supplies most of the alkali—soda ash and caustic soda—used throughout the South and Southwest. Virginia is one of the few states in which pyrites is mined commercially. At Pulaski it forms the raw material for sulphuric acid, the basis of many other chemical developments.

For fuel Virginia is somewhat, but not entirely, dependent upon the generous supplies in the neighboring state of West Virginia. And it is on this substantial foundation of coal, gas and oil that another great chemical industry has been built. Thus West Virginia is one of the most important glass manufacturing centers because of cheap and abundant gas fuel, as well as large supplies of high-grade sand and limestone. Gasoline and hydrocarbons recovered as byproducts of natural gas are being converted by chemical industries in West Virginia into solvents for lacquers and rayon and a host of chemical products used by the rubber, dye, explosives, paint and textile plants of the country.

Salt was one of the first chemical industries of West Virginia, and the recovery of byproducts of the brine such as bromine, and calcium and magnesium chlorides, has continued since Civil War days. More recently electrolytic alkali plants using local brine as well as imported salt as raw material have had a remarkable development. The largest single chlorine plant in the world at Charleston, W. Va., delivers its products by pipe line to a neighboring customer where they are used in manufacturing ethylene glycol and related products of the olefine hydrocarbons. Another plant maintains a similar relation in supplying chlorine and caustic soda for the manufacture of amyl alcohol and derivatives from pentane. In fact, West Virginia demonstrates, perhaps better than anywhere else, the basic interdependence of our chemical industries, the close inter-relationship of products and processes that has been responsible for building up in Germany the great community of chemical interests represented by the German Dye Trust. In America our growth has been along different lines, but there is increasing evidence that important economies lie in close association of chemical producing and consuming industries.

It has been estimated that West Virginia has 160 billion tons of coal stored beneath its mountains. Already it is the leading producer of bituminous coal with an output in 1928 of 133,000,000 tons. Much of this is particularly well adapted for carbonization and West Virginia may be expected to develop into one of the largest coal-processing centers of the country. A rapidly growing nitrogen fixation industry has paved the way for a chemical utilization of West Virginia coal. Others will most certainly follow.

No review of chemical development in the South would be complete without mentioning the part played by Nitro, West Virginia, where the Government spent many millions of dollars to build a great war industry to supply smokeless powder to the Allies. Designed to make 650,000 lb. per day, it reached a daily output of 109,000 lb. in less than 10 months from the time ground was broken for the first plant. Naturally, this great mushroom growth collapsed when war ceased, but gradually in its place have come new chemical developments some of which have already reached leading positions within their industries.

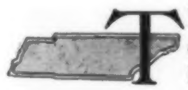
TURNING from the highly developed chemical industries of Virginia and West Virginia we find an interesting contrast in the Carolinas. Here a rigorous industrialization is in progress, yet to date chemical industry has not shared proportionately in this development. Perhaps nowhere else in the South is there a comparable opportunity for highly diversified chemical industry. In the rapidly growing textile industries there is an existing market for millions of dollars worth of chemical products used in the dyeing and finishing of fabrics. The largest denim factory, the largest producer of towels, the largest underwear factories, the largest hosiery mills, are some of these important consumers of chemicals. Charlotte, N. C., Greenville, S. C., and to a lesser extent certain other Carolina cities have become important warehousing and distributing centers for dyestuffs and chemicals, but manufacture has lagged behind. Western North Carolina holds much of interest.

Ceramics, if we may consider it a chemical industry, has almost as attractive an opportunity, for not only is there a large market, but the Carolinas are famous for their deposits of feldspar and kaolin, high-grade shales and clays, many of which are shipped to Northern factories and there converted into ceramic products for Southern use.

Timber is a great resource that the chemical engineer is beginning to put to more valuable utilization. At

Canton, N. C., one of the largest pulp and paper mills in the South has had a prosperous growth. Oak and chestnut are being made into tanning extracts in five Carolina plants representing a $1,500,000 industry. Modern wood preserving plants such as the one at Spartanburg, S. C., are adding value to the products of Carolina forests.

With 11,000,000 spindles in the Carolinas, textile supremacy is not questioned. More recently rayon has entered the field and a $10,000,000 plant at Asheville and a somewhat smaller one at Burlington, N. C., are now in production. The factors that have attracted the textile industry to the Carolinas, namely, cheap and abundant electric power, intelligent and loyal labor of native-born American stock and a plentiful and a wide variety of raw material, will prove equally attractive in developing chemical production to supply the large and growing market.



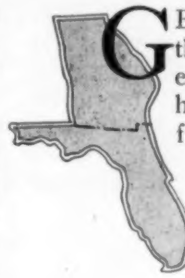
TENNESSEE'S chemical industries have more than one valid claim for our attention. At Copperhill is the largest sulphuric acid plant in the United States, capable of producing 1,100 tons of 60 deg. Be. acid each 24 hrs. A nearby plant at Isabella produces 200 tons daily and within the State there are other producers of this extremely useful chemical. Phosphate rock occurs in abundance in Tennessee where deposits are second only to those of Florida. Thus both raw materials are conveniently available for the superphosphate industry that thrives in Tennessee. Purer phosphate compounds for baking powder and food purposes have been produced by the sulphuric acid method at one plant in Nashville which has recently developed a fuel-fired blast furnace process.

In the newer field of rayon there has been a remarkable development. One of the largest viscose-process plants in the country has been built on the site of the war-time development of Old Hickory near Nashville. In the northeastern corner of the state, in the famous Happy Valley of Tennessee, are the two large plants developed as American branches of long-established German rayon industries. One uses the cupra-ammonium and the other the viscose process. Among other advantages, both plants were attracted to the district, it is claimed, by the almost inexhaustible supply of intelligent native-born American labor that can be drawn from the surrounding country and quickly and easily trained.

A few miles away in Kingsport, Tenn., is a model of industrial development that has attracted national commendation. Chemical industries have played a notable part in the balanced program of industrial integration. Thus a lumber mill supplies the byproducts that are distilled in a wood chemical plant to form some of the essential ingredients of photographic films. Timber is converted to pulp and then to paper which a neighboring printing plant turns into books in what is said to be the largest book printing and binding plant in the world. Another plant produces hardwood extracts for the leather tannery that supplies the binding.

Memphis has become an important distributing center for fertilizers and many chemical products. The largest insecticide plant in the country is there. Chattanooga is more important, however, both as to producing and consuming industries. It is the center of the hosiery, knitting and cotton mercerizing industries as well as many dyeing and finishing plants. Cotton linters are purified here for chemical cellulose uses. A byproduct coke plant at Chattanooga and a large electric furnace production of ferro-silicon are important factors in the growth of chemical industries in that city.

ALABAMA'S famous trinity of iron ore, coal and limestone has underlain the tremendous development that has made Birmingham the Pittsburgh of the South. Chemical industries associated with iron and steel, such as byproduct coke, gas and coal-tar refining, have naturally prospered. There has been a corresponding impetus given to the manufacture of explosives, sulphuric acid and portland cement. Cheap electric power, possible in a state favored with both hydro-electric and mine-mouth steam plants, has contributed to the development and rapid growth of a unique chemical industry at Anniston, Ala., where phosphate rock from Florida or Tennessee is volatilized in an electric furnace to yield a wide variety of high-grade phosphoric acid derivatives. A related company utilizing off-peak power produces calcium carbide, silicon carbide and aluminum abrasives. Except for the two Government plants at Muscle Shoals, there is no plant for nitrogen fixation in Alabama, but the coke ovens of the Birmingham district produce sufficient hydrogen to support a tremendous synthetic ammonia industry. It has been estimated that a plant of 1,000 tons per day capacity might find its raw material here. Compare this with the idle cyanamide plant at Sheffield with a capacity of but 40,000 tons of nitrogen a year.



GEORGIA and Florida, the two largest states east of the Mississippi, have much in common from a chemical standpoint. Both are richly provided with mineral resources that are being commercially exploited by chemical industries or are awaiting industrial use. Both are noted for their development of naval stores, fertilizers and cottonseed products. And because of favorable ports and an efficient network of railroads, both are important factors in coastwise shipping and foreign trade.

Georgia alone has a production of more than twenty-five commercial minerals ranging in importance from the famous clays and kaolins, fullers earth, barytes and bauxite to the lesser known deposits of asbestos, chlorite, chromite, graphite and tripoli. In Florida there is perhaps lesser variety, but the mineral output is just as valuable to chemical industries. The "hard rock" and "land pebble" deposits of phosphate are internationally important for they not only supply approximately 85 per cent of the raw material of American superphosphate plants, but their product is exported in large amount. Other commercial minerals include ball clay, kaolin, fullers earth, limestone, ilmenite and zircon.

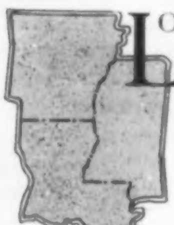
It is evident from this recitation of mineral resources that the ceramic industries must eventually be of great importance in the area. Already Georgia has more than 100 brick, tile, sewer-pipe, cement and clay products plants representing an investment of over $12,000,000. For the most part these are coarser products; however, the finer ceramic wares, table china, floor and wall porcelain, and refrac-

tories, are yet to be developed on a large scale.

The typically Southern industry of naval stores has gone through a great chemical engineering transformation and rejuvenation in recent years. The wasteful turpentine and logging methods of the older days are being displaced by scientific reforestation, improved fire protection and more efficient recovery and refining processes. Likewise an entirely new attack on the whole problem had its start a number of years ago when a noted chemical engineer working at Brunswick, Ga., showed that the yellow pine stumps of cut-over lands could be profitably utilized in making turpentine, rosin and pine oil. The process taken up and developed by the large research staff of a progressive chemical and explosives manufacturer has become the basis for a rapidly-growing industry. Other plants at Pensacola, Fla.; Hattiesburg and Laurel, Miss., and Shreveport, La., are contributing to this development.

Related in its source of raw material is the pulp and paper industry that will inevitably develop in the territory. There is already a scattering of kraft mills, but as the northern supplies of pulp wood are exhausted the industry will turn to such areas as central and southeastern Georgia where natural reforestation takes place in from 15 to 20 years as compared with from 40 to 80 years for northern spruce.

Reference has already been made to the part that transportation is playing in the chemical development of Georgia and Florida. Atlanta has become a great distribution center for the entire southeast, while Savannah, with its excellent port facilities, is the land-water junction in the export shipping of the products of half the continent.



LOUISIANA and the adjacent states of Arkansas and Mississippi have long been important to chemical and metallurgical industries as the source of such basic mineral raw materials as sulphur, salt and bauxite. Within recent years, however, the sulphur deposits of southwestern Louisiana have been practically exhausted and the state's supremacy as the world's largest source has been transferred to the similar deposits in southeastern Texas near the Gulf Coast. But in its place another great resource, natural gas, has made Louisiana an attractive center for prospective development by chemical industry.

Of four important gas fields the one at Monroe is one of the largest in the world. Covering a proved area of 400 square miles, its recoverable reserve is estimated at 4,155,000,000 M. cu.ft. The combined reserves of the other fields at Shreveport, Smackover and Fort Smith about equal that of Monroe, but a new field at Richland just southeast of Monroe may closely approximate it in commercial importance.

Pipe lines now under construction will carry this rich natural gas to the industrial districts at St. Louis and to Birmingham and Atlanta. Chemical utilization has been confined almost entirely to carbon black manufacture, at best a wasteful, uneconomic process. At one time the Monroe fields supplied approximately 75 per cent of the carbon black output of the United States, but to a considerable extent this industry, too, has shifted to Texas.

Now, however, there looms on the horizon the possibility of a more efficient exploitation in which natural gas becomes the raw material for large-scale chemical synthesis. By a simple cracking process the methane will yield hydrogen and ethylene. The latter may some day serve as the basis for producing synthetic acetic acid or even ethyl alcohol. Hydrogen is the more costly of the raw materials for ammonia synthesis, and it is reported that the German nitrogen industry plans to establish a plant in the Monroe area to take full advantage of this economical source.

The same state has long been an important source of salt although as yet this has not been used within Louisiana for the production of alkalis. A single plant has produced salt cake and muriatic acid, the former being used in the plants that make kraft paper from pine wood, and the latter in the sugar refineries of the New Orleans district. Kraft paper manufacturing is one of the rapidly growing industries of Louisiana and Arkansas. Plants at Bogalusa, Elizabeth, West Monroe and Bastrop in Louisiana, and at Camden, Arkansas, have a combined capacity in excess of 700 tons per day. In normal years Louisiana will produce about 3,700,000 tons of sugar cane which will yield about 200,000 tons of sugar, an equal amount of blackstrap molasses, and the remainder of bagasse, much of which is made into wall board and insulating lumber. The blackstrap, on the other hand, is the raw material for denatured alcohol made in a number of distilleries in the New Orleans district.

Louisiana produces about $3,000,000 worth of naval stores, but a much larger output comes from the neighboring state of Mississippi. Reference has already been made to the steam distillation plant at Hattiesburg, Mississippi. Other important naval stores operations center at Laurel, Miss., which is also the center of a new industry in which saw-mill waste is exploded by steam to produce wallboard and insulating lumber.

Arkansas in addition to supplying about 95 per cent of the domestic production of bauxite for the aluminum industry is a promising source of many other mineral products used by chemical industry. Pyrites, manganese ores, clays, soapstone, talc, fullers earth, glass sand are a few that have been exploited. Hydroelectric power developed in western Arkansas and supplemented by that from the steam generating stations using natural gas as fuel, is another resource that may prove a primary factor affecting industrial growth along chemical engineering lines.

DISCUSSION has been confined almost entirely to the South, that is east of the Mississippi. Equally important opportunities for development lie in the Southwest. The tremendous growth of the petroleum industry in Oklahoma and Texas has had a dominating influence. Sulphur and zinc are other mineral resources for which these states now hold first rank. Cottonseed oil production has vastly increased as the cotton growing industry has followed its southwestern trend. There are many other Southern chemical developments that have had to be omitted or given but casual attention here. Those I have cited, however, are typical, I believe, of the great progress that the chemical industries have made within the South during the past ten years. What has been done thus far is merely an earnest of the future, and it requires no prophet to foresee the influence of the chemical industry on the welfare of the South and its people.

Forest Products Chemical Company's Plant From the Air

SOLVENT EXTRACTION Obviates Waste in Acetic Acid Production

By Norman W. Krase

Chemical Engineering Division, University of Illinois, Urbana, Ill.

ACETATE OF LIME has long been the product of the wood distillation industry. In the days when acetone could hardly be obtained from any other source, the production of calcium acetate was justified from an economic standpoint. Today, however, when acetone is both a synthetic and a fermentation product, it is not justified when one recalls that the bulk of this material is bought for reconversion into free acetic acid. The first product of wood distillation, pyroligneous liquor, contains free acetic acid, methanol, acetone, water, esters, and a host of miscellaneous organic compounds. The evaporation of this liquor to separate the more volatile constituents and then neutralization with lime and evaporation to dryness is a comparatively simple industrial operation. To make use of the acid, however, it is necessary to waste an equivalent amount of sulphuric acid in the form of calcium sulphate.

Since acetic acid is produced in the free state and used as such, it seems an unnecessary waste of lime, sulphuric acid and freight charges to continue the present practice.

In recent years much attention has been paid to processes for producing acetic acid direct from pyroligneous liquor. Most of these have been described in the patent literature. There are, in general, two methods. One involves the use of a solvent for the extraction of the acetic acid and the other the use of some substance which forms a minimum boiling (azeotropic) mixture with water and alcohol. Examples of the first method are the Brewster, using ethyl ether; the Melle, using ethyl acetate, and the Suida process, using a high boiling wood oil. Those based on the second method are the Clamecy, using a light wood oil; the Piron, using benzene or toluene, and others using acetone oils and various esters. In this country, the Brewster process and the Suida process are in use.

It is the purpose of the present article to describe the only Suida plant in operation in the United States, namely, the Memphis (Tenn.) plant of the Forest Products Chemical Company.

The process as developed and operated at Memphis differs in several important respects from the European practice; space, however, does not permit a close comparison.

The fundamental principle underlying the process is that acetic acid vapor can be absorbed from a mixture of acid, water vapor, alcohol vapor, etc., by scrubbing with the proper fraction of high boiling wood oil. The acetic acid is recovered from the oil by vacuum distillation and the solvent oil recirculated. The pyroligneous liquor coming from the wood distillation retorts is allowed to settle in storage tanks and the tar that separates is drawn off and distilled in a vacuum tar still to obtain the oil used for the process. The fraction taken usually has a boiling range of 200 deg. C. to 340 deg. C.

The process can best be described by reference to the diagram, Fig. 4. The pyroligneous liquor is drawn from storage through the feed pump, *H*, which delivers at a controlled rate to the copper primary still, *A*. This still is steam heated and the vapors pass into the bottom of the 54-in. bubble-cap scrubbing column, *B*. As the evaporation proceeds the soluble tar accumulates in *A* and is drawn off. The vapors ascending the column, *B*, are scrubbed by the descending oil which enters on the top plate. This oil is fed in at a controlled rate by the feed pump, *J*, drawing from the oil storage tank, *K*.

Fig. 2—20-Plate, 54-Inch Scrubbing Column Above; 42-Inch, 8-Plate Dehydrator Column Below

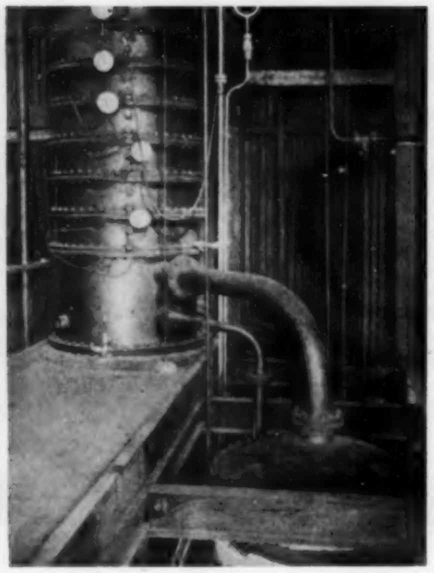


Fig. 3—42-Inch Vacuum Stripping Columns; 10-Plate Column Above; 7-Plate Column Below

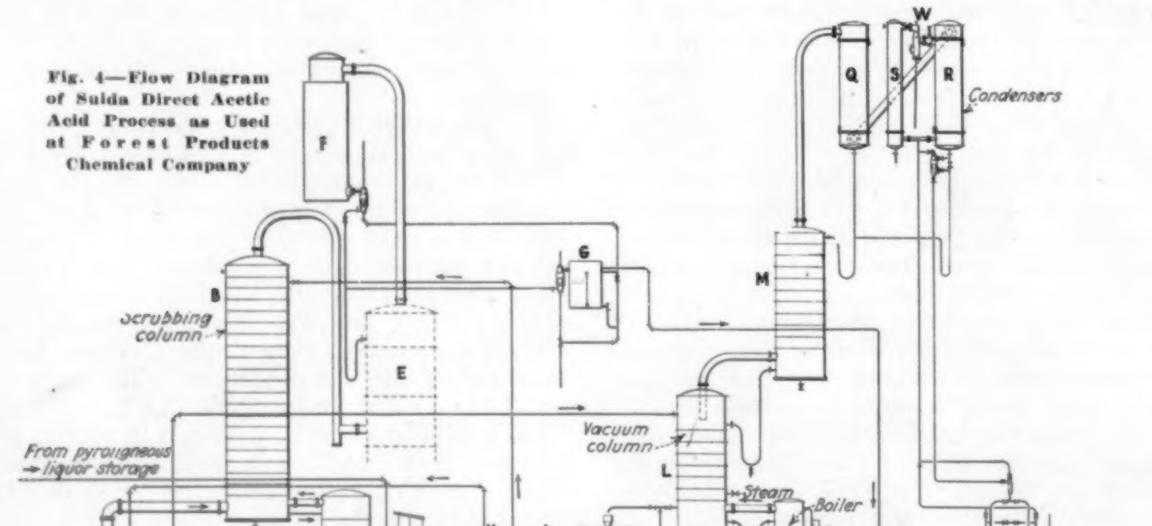
The ratio of oil to acid vapor fed to the column is adjusted to permit complete removal of the acetic acid from the vapors leaving the top of the column. These vapors, carrying all of the methanol, water, and so on, are led without condensation into the weak alcohol column, *E*, and then to the alcohol refinery. A small amount of oil, condensed with the alcohol vapors in *F*, is separated by the decanter, *G*, and returned to the oil circulating system.

The oil and acid mixture leaving the base of the 54-in. scrubbing column carries a small amount of water. This is removed in passing through a 42-in. dehydrating column, *C*, fitted with steam coils. The water together with a small amount of acid vapor passes up into *B*. The oil containing about 5 per cent of acetic acid and a small amount of water passes into a steam heated boiler, *D*. The next step is to remove the acid as completely as possible from the oil. In this operation the acid-bearing oil is drawn by vacuum from the boiler, *D*, into the top of the 42-in., 7-plate vacuum column, *L*. Due to the high vacuum carried in this column the entering oil is superheated and most of the acid flashes off by self-evaporation. The oil passes down through this column which is fitted with steam coils and then down through a vertical copper-tube, steam-heated boiler, *N*, where the last traces of acid vapor are driven off. The acid vapors which are flashed off in the feed section pass upward through another 42-in., 10-plate vacuum column, *M*, and then into a series of aluminum tubular condensers. The partial condenser, *Q*, furnishes reflux for the column, *M*. The condenser, *R*, delivers the condensed acid to the vacuum receivers, *T*. Vacuum is maintained by the steam-jet pump, *W*. The non-condensible gases pass out of the system through *S* after being scrubbed by a small amount of incoming water. This very dilute acid is piped to the pyroligneous liquor storage. The vacuum receivers, *T*, are two in number, equipped with float gages and are periodically emptied by air pressure into the aluminum acetic acid storage tank for shipment.

The stripped oil leaving the boiler, *N*, passes through a cooler, *O*, and is pumped by *P* into the oil storage tank, *K*. At no time is the temperature of the oil below 70 deg. C. The oil used at this plant gradually becomes more viscous with use and is withdrawn from the system approximately every three weeks for redistillation in the vacuum tar still. About half the oil is recovered for re-use in the process.

Pyroligneous liquor on the average contains from 7 to 8 per cent acetic acid as fed to the scrubbing column. The "slop" or scrubbed vapor going to the weak alcohol column carries from 0.3 to 0.4 per cent acid. The recovery of acetic acid is, therefore, between 95 and 96

Fig. 4—Flow Diagram of Suida Direct Acetic Acid Process as Used at Forest Products Chemical Company



per cent. Steam consumption as determined from an actual test made May 8, 1929, is shown in Table I.

Data taken from the process during operation January 2, 1929, are shown graphically in Fig. 5. Samples of the vapor above each of the 20 plates in the scrubbing column were analyzed for acetic acid. The graph shows practically complete removal of acid from the vapor at the top plate and high concentrations in the vapor in equilibrium with the outgoing oil. Plate temperatures are shown opposite every other plate. Conditions in the vacuum stripping column are also shown graphically. The operating conditions at the time data were taken are shown in Table II. The oil had been used about six days when the test was made.

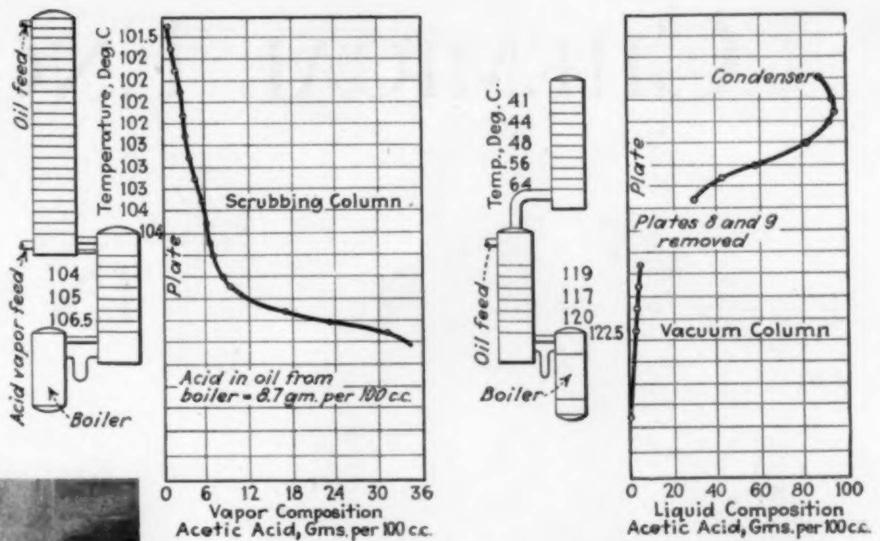


Fig. 5—Vapor Composition in Scrubbing Column (Left) and Liquid Composition in Vacuum Stripping Column (Right)

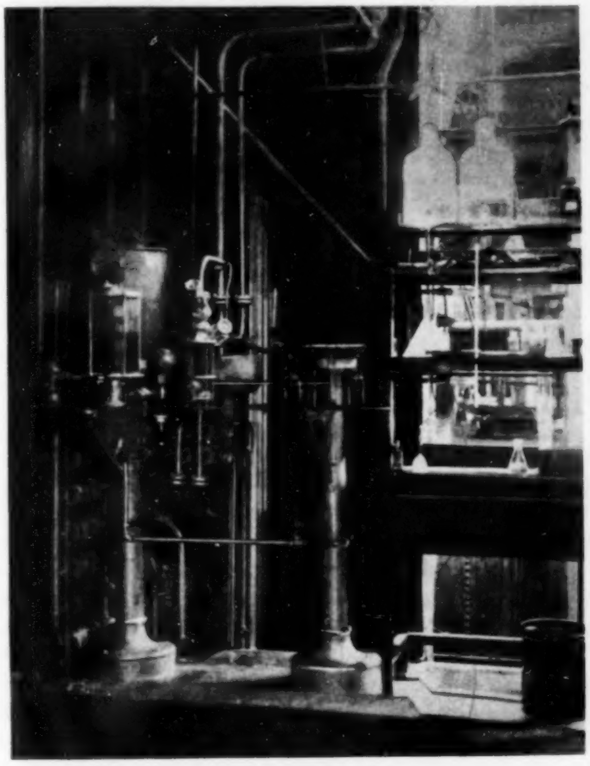


Fig. 6—Test Bench and Tail Boxes for Methanol and Acetic Acid Condensates

Chemical engineers at the Forest Products Chemical Company have accomplished pioneer work in developing and operating the Suida process. Very few data of fundamental importance in design exist and much of the physical chemistry involved is still obscure. Much research is necessary for a thorough understanding of the process, although its commercial feasibility has been successfully demonstrated. Between 8,000 and 9,000 gallons of pyroligneous liquor are treated daily by this process and enlargement is planned.

Table I—Steam Consumption Data

Acid liquor feed	4.59 gal../min.
Scrubbing oil feed	6.48 gal./min.
Steam pressure	105 lb./sq. in.
Acid product	83.5 g./100 c.c.
Vacuum	28.9 in. Hg.
Temperature scrubbing boiler	150°C.
Temperature vacuum boiler	155°C.
Condensate, scrubbing column	1,021 lb./hr.
Condensate, vacuum column	276 lb./hr.
Total Condensate (1021+276)	1,297 lb./hr.

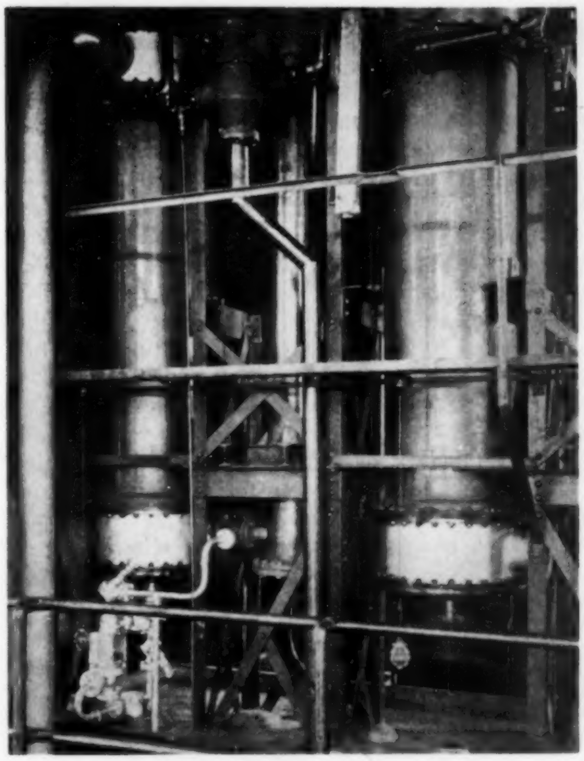
$$\frac{1297}{4.59 \times 60 \times 8.34} = 0.565 \text{ lb. steam/lb. feed.}$$

The writer expresses his sincere thanks and appreciation to the officials of the Forest Products Chemical Company and particularly to T. C. Albin, chemical engineer in charge, for all the information and data in this article and for many courtesies during his visit.

Table II—Operating Conditions During Test

Oil feed	5.0 gal./min.
Liquor feed	4.4 gal./min.
Acid from condenser	87.9 g./100 c.c.
Acid in slop	0.56 g./100 c.c.
Acid in stripped oil	0.70 g./100 c.c.
Temperature scrubbing column boiler	148° C.
Temperature vacuum column boiler	150° C.
Temperature vacuum column top plate	40° C.
Vacuum	28.4 in. Hg.

Fig. 7—Partial Condenser at Right and Final Condenser at Left; Tail Gas Scrubber and Steam Jet Pump in Center



CHEMICAL ENGINEERING

IN THE "*Land*

Next month the American Institute of Chemical Engineers meets in Asheville, N. C. It is therefore fitting to present this brief summary of outstanding industries of the district. A better view will be obtained, of course, by those who are fortunate enough to attend the Asheville meeting and to visit some of the interesting plants briefly described here.

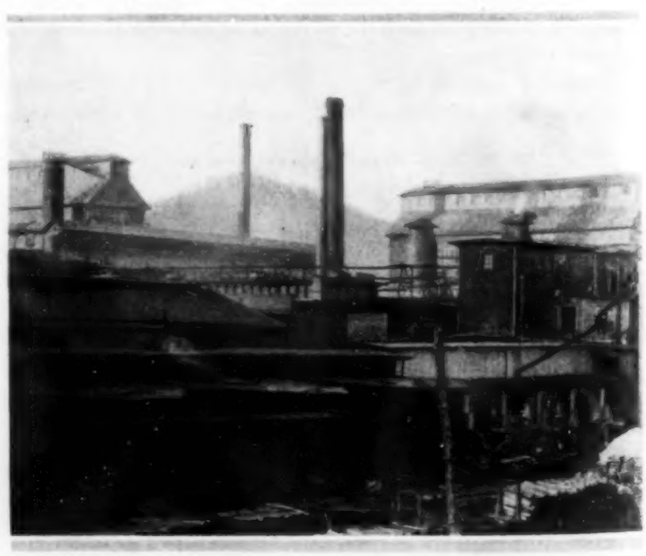
WESTERN NORTH CAROLINA—in contrast with the thriving industrialism of the adjacent Piedmont—has long been noted for its scenic beauty, the variety of its mineral resources and the various woods cut from its timbered mountain sides. More recently with the production of cheap power, resulting either from the harnessing of rushing mountain streams or from the construction of modern steam plants, there has come the beginning of a promising industrial development in which chemical engineering seems destined to play an important part.

Just across the state line in the neighboring Happy Valley of Eastern Tennessee are the huge new rayon plants of American Bemberg and American Glanzstoff—and, within the past year, the establishment of the $10,000,000 plant of the American Enka Corporation at Asheville, N. C., has made this area an important center for our newest chemical engineering industry. Not far away, too, is the interesting development of the group of co-ordinated chemical engineering industries of Kingsport (see pages 670 to 673 in this issue). Near Knoxville, at Alcoa, is the large metal reduction plant of the Aluminum Company of America, which is now being expanded by the addition of an aluminum-bronze fabricating mill. Those familiar with the history of this great electro-metallurgical development will recall that Baden, N. C., was the scene of some of the pioneer work on aluminum, and the company still operates an important hydro-electric development there. Likewise it was in this vicinity in the early eighties that Willson invented and developed the first commercial process for producing calcium carbide. It is significant that in less than forty years, these two industries have grown on an international scale to a position of tremendous importance. Aluminum has become the fourth metal in point of volume produced in the world today. Carbide, the basis of cyanamide, acetylene and various synthetic organic chemicals, represents one of the largest electro-chemical developments.

But in recent years, chemical engineering interest in western North Carolina has centered in the development of great natural resources—minerals, timber, water power, and, of not the least importance, the abundant, native-born labor supply. North Carolina ranks fifth in the United States in water-power development. In the Southern states, it ranks second in output of its power plants (1,730,861,590 kw.-hr.) and also second in the output of its water power (1,025,278,570 kw.-hr.).

Among the important mineral raw materials for which this region is noted are feldspar, mica, kaolin, pyrophyllite and other clays, talc, marble and limestone. Rarer

Tannin Extract Plant Operated in Connection With



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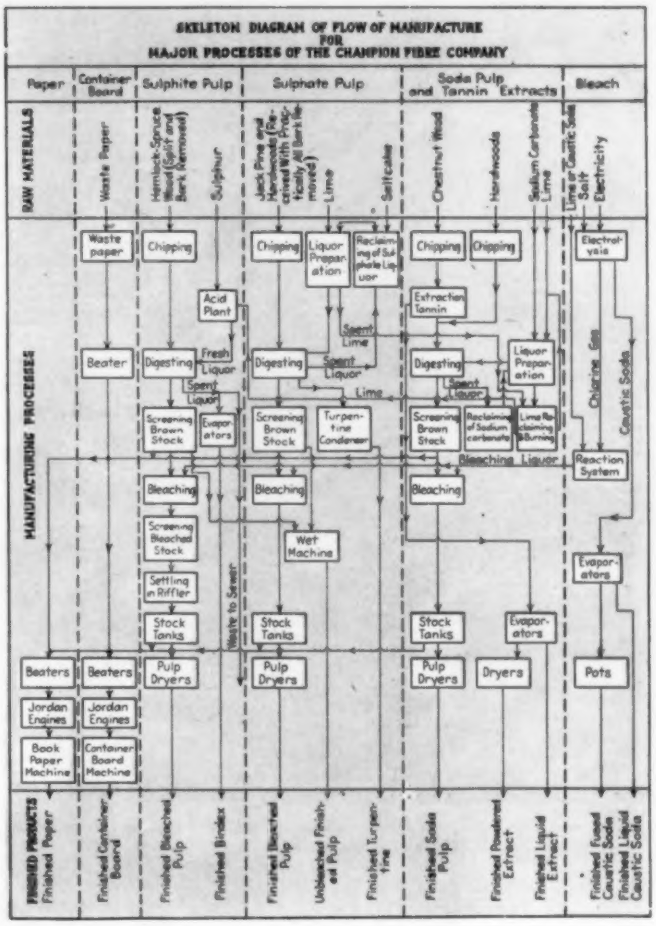


minerals, such as zircon, chromite, monazite and rutile, are all found in North Carolina, yet, for various reasons, they have not been exploited commercially. In point of value, feldspar, with an output of 105,560 tons in 1928, leads the list of the 260 native minerals found in North Carolina. This places the state in the front rank, with almost exactly 50 per cent of the total United States production of feldspar. The North Carolina output in 1928 was 3½ times that of New Hampshire, the second producing state.

Feldspar processing is fast becoming a chemical engineering industry. Some of the larger plants, such as that of the Tennessee Mineral Products Company, of Spruce Pines, N. C., which was described by Frank P. Knight, Jr., in *Chem. & Met.* for September, 1928, pages 562-3, have introduced chemical control and modern grinding methods. Others, spurred by the intense competition, have greatly improved their operations. The next step, not as yet consummated on a large scale, is the utilization of the spar by domestic industries in the manufacture of dishes, sanitary and electrical porcelain, enamelled ware, terra cotta and similar ceramic products. Kaolin and most of the types of clay required are available locally, but the processing movement to establish a sizable ceramic industry would be greatly accelerated if electric firing of the ware could be satisfactorily developed.

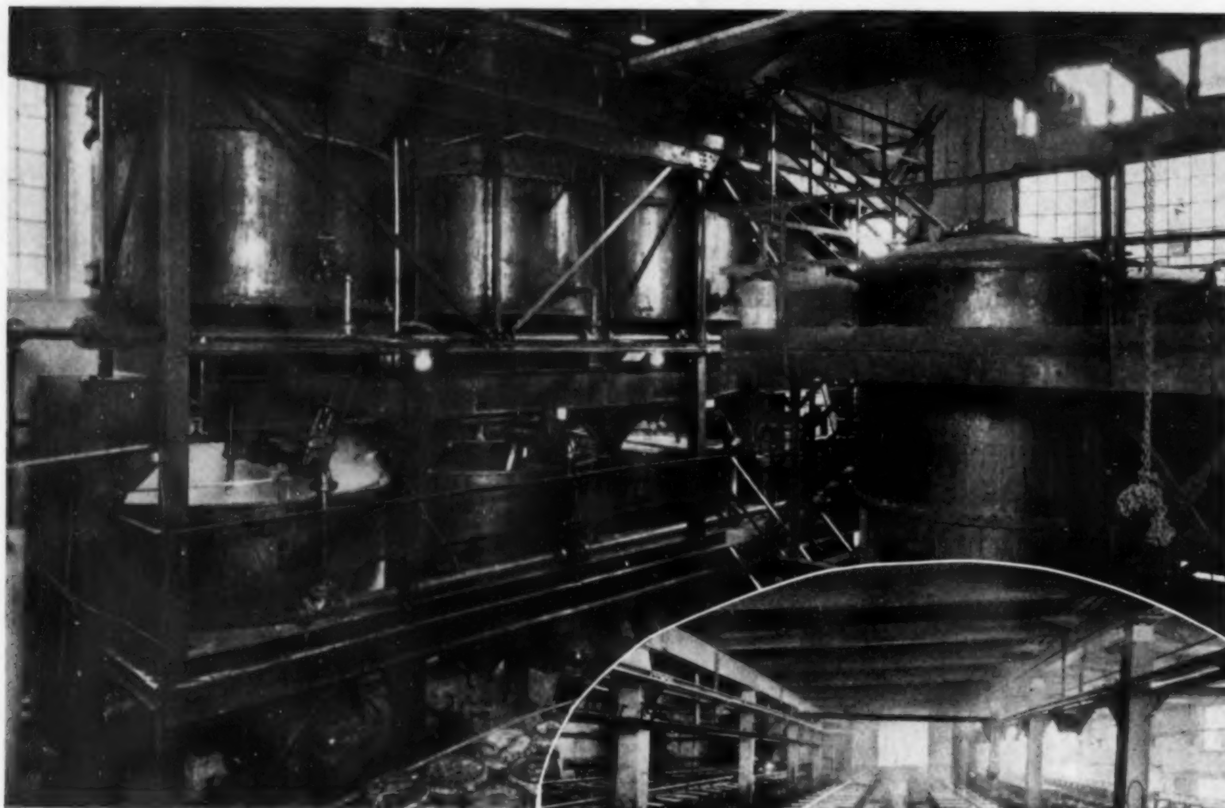
In addition to the usual "mountain woods" of the South—spruce, pine and hemlock—the forests of western North Carolina still yield abundantly of such species as oak, chestnut, maple, gum, ash, cherry, birch, walnut and hickory. Supplementing the usual lumbering operations and related wood working industries, the region possesses several of the larger tannin-extract plants in the country. A kindred industry, wood preservation, is well represented. But the most interesting utilization, from a chemical engineering viewpoint, is, of course, the manufacture of pulp and paper, best exemplified in the operations of the Champion Fibre Company at Canton, N. C. It is the purpose of the following articles to describe briefly some of the outstanding chemical engineering enterprises of the Asheville district.

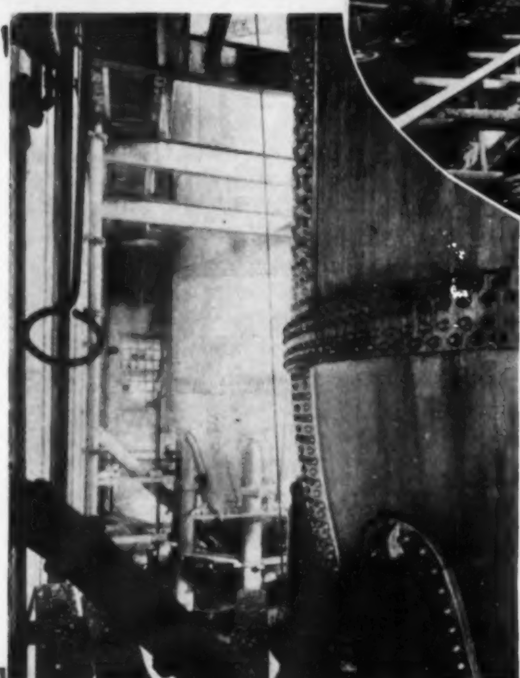
Pulp and Paper Manufacture at Canton, N. C.

A Truly Diversified Industry

A COMPLETE pulp and paper industry using any one of the three standard processes—soda, sulphide or sulphate—is in itself a complicated undertaking. But when an industry is built to use all three of these processes in simultaneous production and, in addition, operates a sizable electrolytic alkali plant, one of the largest tannin-extract factories in the country, its own coal mine and chemical lime plant, and produces container board, turpentine and adhesives as byproducts—then that industry may well be said to represent a truly diversified chemical engineering enterprise.

A careful study of the accompanying flow sheet of the major manufacturing processes employed by the Champion Fibre Company, will reveal the extent of this development from the technical standpoint. Some idea of the magnitude of the operation at Canton is to be gained from the following statistics: Each day more than 50 standard carloads of wood are shipped in from the sur-

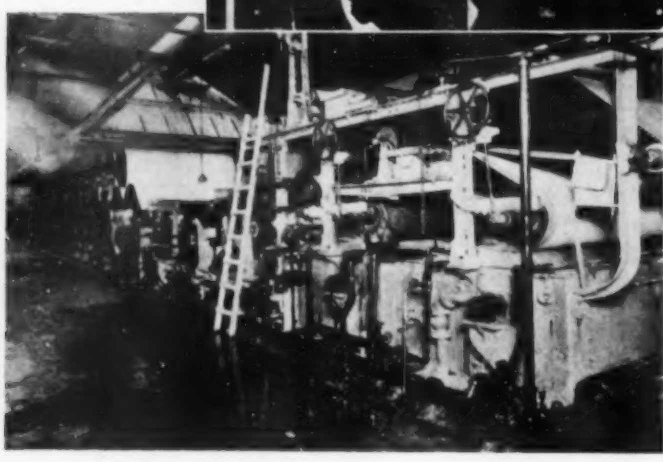


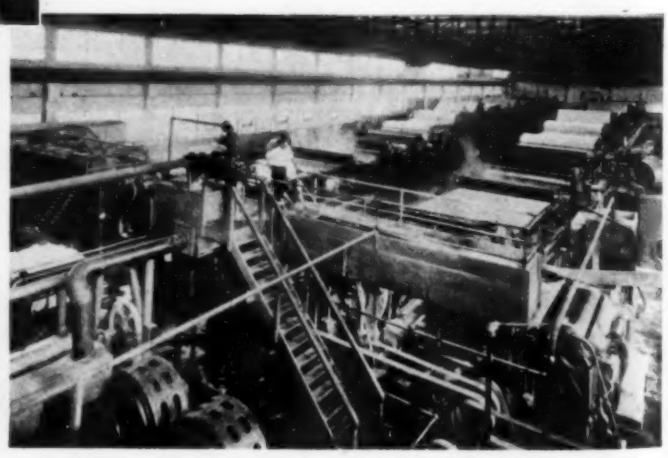


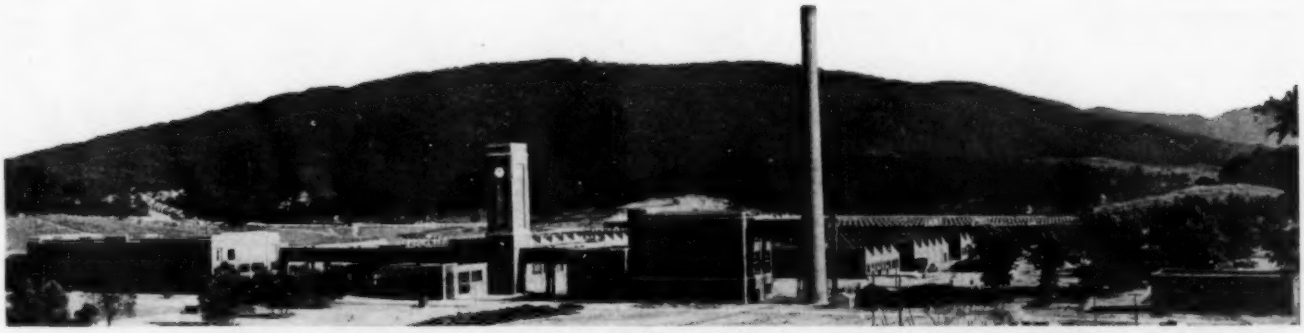
Caustic soda solution is settled and the fused salt prepared in the "caustic pots" shown at the top of this page. At left is the base of the sulphite digesters.

Chemical Phases of Pulp and Paper Industry

These random views in the great plant of the Champion Fibre Company reveal its diversity of chemical engineering operations. Above is the electrolytic-cell room for caustic soda-chlorine production. Below are the pulp and book-paper machines.







New $10,000,000 Rayon Plant in the Outskirts of Asheville, N. C.

rounding area to be converted into approximately 150 tons of finished paper—kraft, wrapping, sulphite bond, book and postcard. More than 300 tons of chemical wood pulp and 40 tons of pulp board are made each 24 hours. The daily output of tannin extracts, liquid and solid, is 100 tons. The alkali plant produces 15 tons of fused caustic soda per 24 hours. Of the byproducts, 300 gal. of turpentine and 50 tons of bindex (adhesive) are produced in the same period. The monthly consumption of chemical raw materials is approximately as follows: Alum, 35 tons; soda ash, 600 tons; lime, 1,000 tons; salt, 750 tons; salt cake, 750 tons; sulphur, 320 tons; and chlorine, 300 tons.

Established in 1906 by Peter G. Thomson, Sr.—now chairman of the board of directors—the Champion Fibre Company has grown until it now employs more than 2,000 men and has extended its operations over a good part of western North Carolina and eastern Tennessee. In addition to the plant at Canton, the company operates its own coal mines at Coal-Creek, Tenn., producing 1,200 tons daily, about one-half of which is consumed by the company for steam generation. Near Knoxville, Tenn., the company owns a plant for the production of chemical lime from waste marble. In connection with its timbering operations—conducted within a radius of approximately 250 miles—the company conducts a program of reforestation looking to the continuity of the supply of its raw material.

Upon completion of two new Heine-type boilers, now being installed by the International Combustion Engineering Corporation, the company will have a steam generating capacity of approximately 35,000 hp. For the privilege of presenting this information, *Chem. & Met.* is indebted to R. B. Robertson, president and general manager of the Champion Fibre Company; Charles S. Bryant, secretary and treasurer, and Robert Griffith, manager of chemical sales.

Enka Exemplifies Many Ideals

ANOTHER chapter of the amazing story of Southern industrial development was written recently with the completion of the $10,000,000 rayon plant of the American Enka Corporation near Asheville, N. C. Here in the peaceful valley of Hominy Creek, surrounded by towering mountains, there now stands a mammoth plant that covers 75 acres of land and provides over 20 acres of actual manufacturing floor space. On Sept. 25, 1928, when A. J. L. Moritz, vice-president, closed the deal for this property, it was ordinary farm land. Two days later representatives of the engineering construction firm of the H. K. Ferguson Company, of Cleveland, were at work on the ground and in almost exactly nine months viscose was being pumped through the spinning machines. Today the plant is capable of producing 17,500 lb. of viscose yarn per day, with an ultimate production of 30,000 to 35,000 lb. per day being provided for.

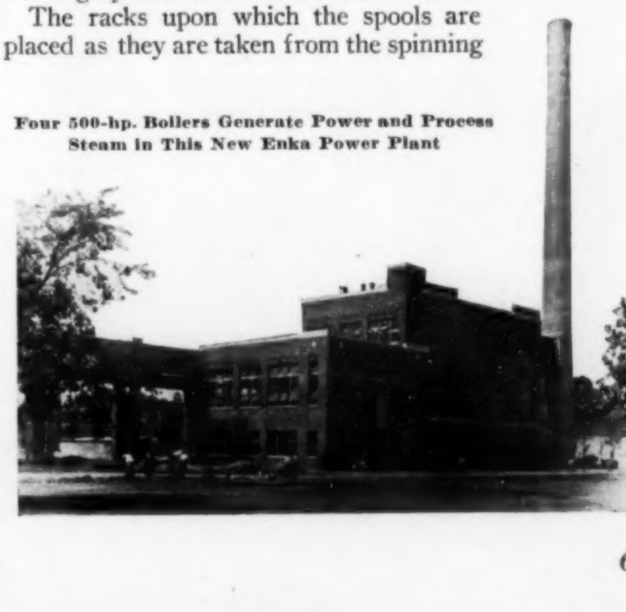
The American Enka Corporation is a subsidiary of the Dutch Enka Company (Nederlandische Kunstzijdefabriek, ENKA, of Arnhem, Holland). The site near Asheville was selected because of the many advantages it offered for rayon manufacture. An abundance of soft water, an equable climate, and a plentiful supply of intelligent native labor were the leading factors in the choice made from a total of 90 different locations which were surveyed by the company's engineers.

The plant proper consists of nine complete factory structures of brick and steel construction. The chemical building, shown at the left in the accompanying photograph, is three stories high and has an ample basement. The twisting building is of two stories and the rest of the plant is of one-story construction. The special sawtooth design was developed to provide an 82-ft. span between columns with a row of glazed sash every 28 ft. The sash is of aluminum in the parts of the plant where corrosive fumes are met. Double glazing is employed where artificial humidity is maintained. The roof deck is composed of 3-in. plank overlaid with 1-in. layer of cork insulation with a built-up waterproofing and an all-white surface which reflects light and heat.

Referring again to the photograph, the "L" shaped building at the left contains the chemical department in which the cellulose is transformed into viscose and is pumped to the spinning building, which is located adjacent to the viscose department. This building is equipped with 72 spinning machines, each one having 120 spinning places. After the viscose mass is subjected to the coagulating bath of acid and is formed into filaments, the resulting fibers are wound on spinning spools and transferred to the washing machines, where they are thoroughly cleansed of all traces of acid.

The racks upon which the spools are placed as they are taken from the spinning

Four 500-hp. Boilers Generate Power and Process Steam in This New Enka Power Plant



Picturesque Setting of the Hans Rees Tannery With the City of Asheville in the Background

machines are next carried to the drying machines for treatment under controlled conditions of humidity and temperature. The dried spools are then transported to the twisting department, in which 160 twisting machines are installed. The product receives the required twist and then proceeds through the reeling, bleaching, final drying, sorting, packing and shipping departments—following almost a straight line to the railroad siding, where the final product leaves the plant.

Other buildings in the factory group, in addition to the chemical structure, include the chemical laboratory, the power plant, filter station, cafeterias, and general supply and storerooms. Separate buildings also provide for pump control, instrument making shop, machine shop, blacksmith shop, electrical shop, carpenter shop, lead burner shop, glass blower shop, medical department, and the labor employment bureau.

Although a portion of the plant's electric power is purchased from the Carolina Power & Light Company, the Enka power plant supplies the balance. Four Babcock & Wilcox Stirling 500-hp. boilers, operating at 350 lb. and equipped with Riley stokers, have been installed in the power house, while the turbine room is equipped with two Allis-Chalmers 550-volt turbines of 2,000 kw. capacity each.

In the construction of the plant it was necessary to divert the course of Hominy Creek, which supplies the plant with its daily requirement of 5,000,000 gal. of water, since the creek crossed the site in which the buildings are now located. The new section of the stream's channel is more than a mile in length. The water system also includes an artificial lake for use as a storage and settling basin, with a capacity of 300,000,000 gal. The filter plant shown at the extreme right of the photograph is equipped to handle 5,000,000 gal. every 24 hours.

In addition to the land composing the actual site of the factory, the American Enka Corporation has purchased 2,000 acres of surrounding farm and mountainous territory to provide the employees with picnic grounds and other recreational advantages. The first unit of 100 residences, consisting of 15 different designs of five-, six-, and eight-room brick cottages and garages, has been completed. The construction of these houses and the installation of the service facilities are in charge of Lockwood Greene Engineers, Inc., the firm that in conjunction with J. M. Vanden Bosch and J. W. Lubberhuizen, chief engineers of the company, designed and installed the mechanical equipment for the Enka plant.

The president of the American Enka Corporation is Dr. J. C. Hartogs, of Arnhem, Holland, managing director of the Dutch Enka. The operating management in the United States is under the direction of A. J. L. Moritz, who had been associated with the Dutch Enka since its organization in 1911. Acknowledgment is made to Dr. J. J. Schilthuis, chief chemist, and to S. B. Lincoln, of Lockwood Greene Engineers, Inc., for their co-operation in making available the material for this brief article.

Tannery That Makes Its Own Tannin Extracts

IN POINT of service, the Hans Rees tannery, founded in 1846, is one of the oldest of the process industries in the Asheville district. First established there in 1896 as a general leather tannery, it has since specialized largely in the production of leather for power belting, which now accounts for fully 50 per cent of its output. Hydraulic packings and special leather for shoes, harness and various novelties make up the remainder. About 30,000 lb. of cattle hides are processed daily. The plant, comprising more than two dozen buildings, is on a 22-acre tract, between the French Broad River and the Southern Railway Station and track at Asheville.

An interesting chemical engineering feature of the plant is its production of chestnut oak bark extract, which is used chiefly with quebracho and chestnut wood extract in tanning. The chestnut oak bark obtained from the nearby forests of western North Carolina is finely ground and leached with hot water in open wood tanks by counter current extraction.

The tannery is operated by the Hans Rees' Sons, Inc., of New York, of which Harold Rees is president. The first vice-president and local manager of the plant at Asheville is C. E. Rudd.

NOT ITSELF a chemical industry, but an important user of chemicals and chemical processes, the Sayles-Biltmore bleachery holds much of interest to chemical engineers. The large plant on the Swannanoa River at Biltmore, in the outskirts of Asheville, is a splendid example of modern construction. Further, it is evidence of the trend that is bringing more and more of the dyeing, finishing and chemical processing units to the Southern textile industry.

Sayles-Biltmore is one of the five units of the Sayles-Finishing Plants, Inc., which operates bleacheries, print works and dyeing plants at Saylesville and Phillipsdale, R. I. The Biltmore plant bleaches and finishes the so-called "gray goods" of the cotton and rayon weaving plants. It does this on a commission basis, having a capacity of about 2,000,000 yards per week. Several hundred employees of this plant are housed in an attractive village on the 200-acre site of the plant. The plant generates its own power, filters and softens its daily requirement of water. Several tons each of caustic soda and chlorine are used monthly, in addition to smaller quantities of dyestuffs and miscellaneous chemicals.

Another Southern industry to develop as a branch of a Rhode Island organization is the Beacon Manufacturing Company, of Swannanoa, which specializes in the manufacture of cotton and cotton-wool blankets. As a result of recent expansion of manufacturing facilities, this plant will have an annual output of over 1,200,000 blankets. In a single week recently, the company had a record shipment of 40 carloads of blankets, averaging 2,600 in each car. The company carries on a complete manufacturing operation, which includes the dyeing and finishing of its own yarn, as well as the weaving of the blankets, the napping and other purely textile operations.

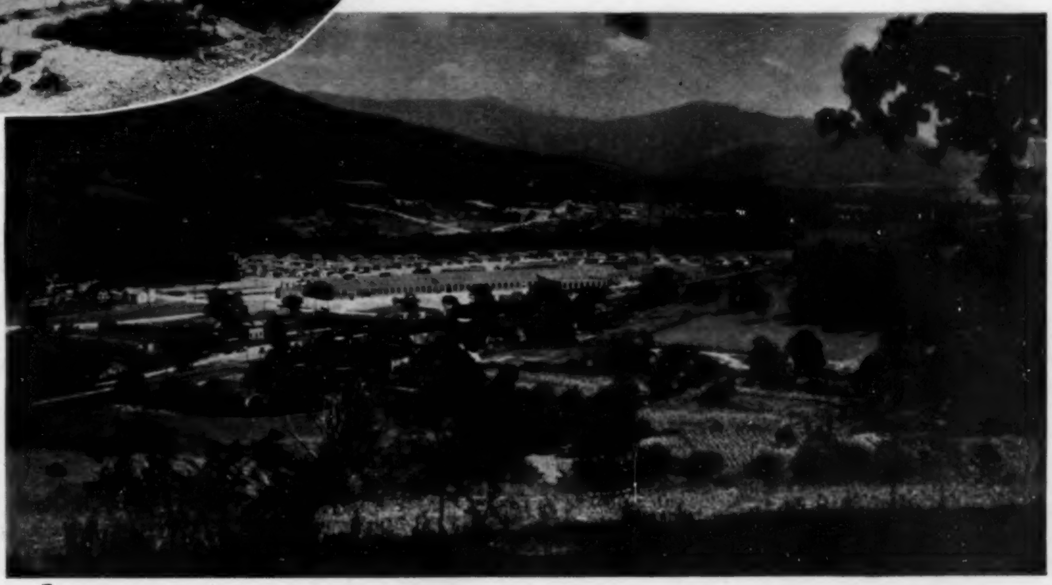
On the hillside, directly adjoining plant site, the company has built a village to take care of its 600 employees. Frank E. Laycock is superintendent of the plant.

Gluconic Acid Manufacture Indicated

GLUCONIC acid can be made on a commercial scale by fermentation of dextrose solutions with efficiencies approaching 60 per cent of theory in a manufacturing cycle of eleven days. This important general conclusion seems amply justified by the semi-plant-scale investigations of the production of gluconic acid by mold fermentation reported by Orville E. May and Horace T. Herrick. These chemists of the color laboratory of the Bureau of Chemistry and Soils presented their conclusions on Oct. 18 at the inter-sectional meeting of the Maryland, Virginia, and Washington sections of the American Chemical Society.

The process consists in fermenting dextrose solutions with a strain of *Penicillium luteum purpurogenum*. The optimum conditions of concentration, temperature, nutrient-salt content, surface-volume ratio, subsurface stirring, and pH of the medium are all rather accurately fixed by the results of the study. The investigations also establish certain limits of container materials which must be observed. Metals, such as nickel, lead, copper, and Monel, withstand action of gluconic acid, but are toxic to the mold; iron, zinc, and ordinary commercial aluminum do not interfere with the mold growth, but are appreciably attacked by the acid. Block tin, though apparently satisfactory on both scores, is too costly to consider commercially. Low-grade enamel ware disintegrates under gluconic acid attack, but a good grade of acid-proof enamel or glass will serve. Commercial nitro-cellulose enamels on iron serve well initially, but are disintegrated during repeated sterilization with the formation of products which interfere with the fermentation. Final choice and recommendation as to the plant material was aluminum of 99.5 per cent purity containing less than 0.1 per cent of copper or manganese.

The semi-works-scale investigation was made in pans 43 in. square with controlled air supply. Pre-cooled air was blown over the pans, both to dissipate the heat generated by the oxidation and to supply fresh oxygen. The gluconic acid formed in solution is readily recovered as calcium gluconate with ordinary neutralization, concentration, and crystallization. The authors point out that high efficiency, short operating cycle, and relatively low cost of installation and operation give promise of production of gluconic acid at a very favorable figure.



Two Plants Engaged in the Chemical Processing of Textiles

Above is the new Sayles-Biltmore Bleachery shown during its construction. *Below* is the blanket plant of the Beacon Manufacturing Company located at Swannanoa. Both are in the outskirts of Asheville.

Some Considerations in

Electrothermal Production of Phosphoric Acid

By Bethune G. Klugh

Vice-President, Federal Phosphorus Company, Birmingham, Ala.

EXTRACTION of phosphorus, as such, from tricalcium phosphate existing as natural mineral, or from bones, by reduction at elevated temperatures, is an old art. Likewise, application of electrical energy toward obtaining the necessary temperature has been practiced for many years. The production of phosphorus and its subsequent oxidation and hydration for the manufacture of highly concentrated and relatively pure phosphoric acid has been in fairly general practice for at least a quarter of a century. During this period a number of attempts were made to perform the reduction, reoxidation, hydration and collection step in one continuous operation. Since each of these steps presents inherent difficulties when performed separately, the combination into a unit operation multiplied the difficulties. Problems involving efficient recovery of phosphorus from the natural product, economical power consumption, complete oxidation to P_2O_5, effective separation of P_2O_5 and H_3PO_4 from the gases, collection of the acid in pure and concentrated form and maintenance of equipment, appear to have defeated substantially all attempts toward profitable application of the completely unified operation.

One outstanding exception, however, lies in the operation of the Anniston (Ala.) works of the Federal Phosphorus Company. The process was successfully developed in 1920 and 1921. It has continued in profitable operation to date, having produced over 30,000,000 lb. of P_2O_5 annually in the form of acid meeting the most rigid food-grade specifications. The high concentration of the acid and the substantial absence of iron and aluminum phosphates and other phosphate-processing deterrents renders the acid made by this process particularly attractive for the production of the concentrated, soluble fertilizer and chemical compounds which agriculture is demanding more and more urgently.

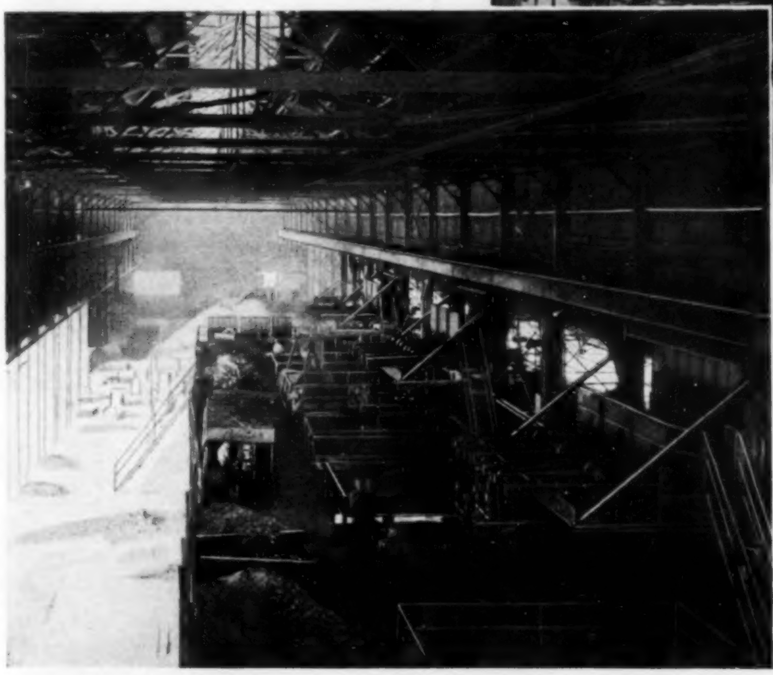
A plant embodying this process has just been put into operation in southern France by the Société des Phosphates Tunisiens. This plant was designed completely by the Federal Phosphorus Company's engineers, and put into production by its technical staff. Its capacity is substantially twice that of the Anniston plant. The phosphoric acid produced will be used primarily in fertilizer compounds, such as diammonium phosphate, which is made by a process and plant likewise developed and designed by the Federal Phosphorus Company's engineers. A third and still larger plant, using these same processes, is projected in Europe.

In principle this process consists in smelting a mixture of phosphate rock, siliceous flux and carbonaceous reducing agent, with electrically generated heat. The opera-

Anniston (Ala.) Plant of Federal Phosphorus Company From the Air

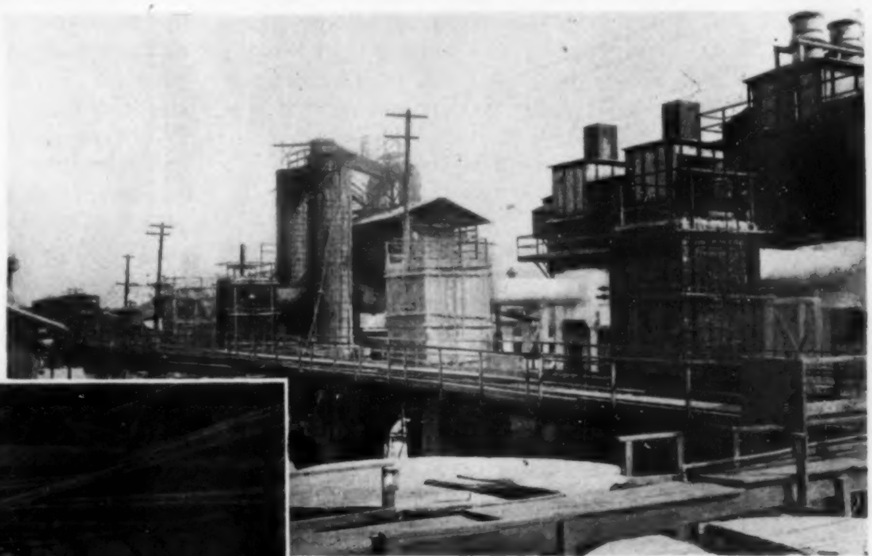
tion is continuous. The smelting mixture, properly proportioned according to analysis of the constituent materials, is fed continuously into the furnace. The slag and metal (ferrophosphorus formed from the iron in the raw materials) are tapped out periodically.

The phosphorus is reduced from the oxides in complex combination in the phosphate rock. Then phosphorus vapor, with the CO produced in the reaction, passes up through the interstices of the smelting charge. Issuing from the surface of the charge, these gases are burned with oxygen from air admitted under controlled conditions to P_2O_5 and CO_2. The temperature of the resulting combustion products ranges from 1,500 to 1,700 deg. C., depending upon the amount of excess combustion air and its temperature. With these products burning at such high temperature in contact with the incoming cold stock, a great degree of heat recovery is made possible.



Below, Electric Furnaces for Phosphoric Acid Production

Charging platform and furnaces at the right of the view are elevated above ground level. A crane drops the charge beside the furnaces, after which it is shoveled into the furnaces around the three electrodes. Slag and metal are tapped off on the lower level, metal being caught in ladles and slag overflowing on the ground.



Above, Hydrators and Precipitators for Forming H_3PO_4 and Preventing Its Loss

Furnaces are out of sight at the left. They connect by large flues to the square towers, where P_2O_5 is absorbed in water. The small square structures above and behind the hydrating towers are Cottrell precipitators. The round wooden towers are for fluorine recovery. Tanks in the foreground are used in purification of phosphoric acid.

The fundamental principle of the furnace reactions in this operation apparently is not well understood. The reaction usually is described as

$$(CaO)_3P_2O_5 + 5C + SiO_2 = P_2 + 5CO + (CaO)_3(SiO_2)_2$$

Without the SiO_2, the phosphorus reduction is effected only at very high temperatures, and then with the formation of complex products of phosphorus, calcium phosphide, and some phosphorus oxides. Without the carbon, even higher temperatures are necessary to separate the CaO from the P_2O_5, and with limited completion. It appears necessary to have the two reactants, carbon and SiO_2, work simultaneously to give efficient extraction. Both have definite functions to perform and must cooperate. A deficit of one or the other is disastrous to the process.

Temperatures in the hearth higher than normal operation cause volatilization of CaO, Al_2O_3 and SiO_2 from the charge. These appear as complex compounds with P_2O_5 in the product. Such conditions are disastrous to quality and utility of the product and are ruinous to the electrical characteristics of the furnace operation. In practice these conditions have been obviated to the extent of obtaining better than 97 per cent load factor on these furnaces continuously. The fundamental principle of the reaction above described should be better understood, and exhaustive research to that end is highly desirable.

From the effective combustion chamber, the floor of which is the furnace charge, the gases pass through mains and gradiently controlled cooling equipment. At the proper degree of cooling and velocity of gases, the hydration of the P_2O_5 to H_3PO_4 is effected by means of an atomizing water spray. This detail is a most important step in maintaining the proper concentration of acid and preventing formation of colloidal silico-phosphates resulting from the reaction of the P_2O_5 and fluorine compounds with the refractories.

A portion of the concentrated acid is collected in the hydrating and cooling towers, but the principal product is recovered in Cottrell precipitators. The collected acid is of about 85 per cent H_3PO_4 content, water-white, and with but small content of lead, arsenic and SO_2. These impurities are removed by subsequent treatment to conform the acid to food specifications. For use in fertilizers, the acid is ready for shipment as collected.

From the charging of the smelting mixture to the pumping of the acid from the receiving basins, all control of the many factors essential to successful operation is substantially automatic. Natural phosphate rock, without the expense of any preparation such as briquetting, roasting, or other treatment, is used. The wide range of classes and character of rock used testifies to the flexi-

bility of the process as it has at present been developed.

Materials of construction to resist the erosive and corrosive action of the reactants at high temperature presented serious problems in the early stages of development. For some time it appeared that this feature would completely defeat the commercial application of the process. These problems have, however, all been solved. Furnace linings have been in continuous service for over seven years. The operating time is around 99 per cent when electric current supply is uninterrupted.

The furnaces constructed and operated to date range in size up to 5,000 kw. input. Furnaces of 10,000 kw. and higher appear entirely feasible and, in fact, drawings are completed and construction projected at present for at least one 10,000-kw. furnace. The limiting factor in size of furnaces will be the incidental electrical equipment, such as electrode sizes available and arrangement of connections. On the other hand, the simplicity of operation and the small labor requirement is such that there is a limit to the economies obtainable through greatly increased size. It appears as if the limit of heat losses by conductance through the furnace walls will be reached with furnaces of about 10,000 kw. capacity. The design and construction now developed brings this factor down to less than 5 per cent. Larger sizes might reduce it by 1 per cent, but this possibly would be balanced by increased installation cost per unit of output.

In order to set up a hypothetical basis for discussion of the principles of phosphate smelting, Table I, a theoretical metallurgical balance of electric furnace phosphorus production, is submitted. This is based upon an arbitrary phosphate rock analysis for which the siliceous flux and carbonaceous reducing agent is calculated. The recovery shown is considered rather poor practice, but is assumed in this case to represent a certain typical operation.

From this metallurgical balance, Table II is developed, showing the thermal balance for the assumed conditions. It is noted that the theoretical energy consumption with this smelting charge is 2.21 kw.-hr. per pound of P_2O_5 in acid and metal. This is the net figure, when carrying the reaction only to the stage of P and CO. The most interesting figure is that of the energy liberated from combustion of the CO and P to CO_2 and P_2O_5, which is slightly more than the net total required for the smelting reaction. Of course, the recovery of all this energy through heat exchange is not possible, but every 3,412 B.t.u. that is returned to the furnace charge replaces 1 kw.-hr. of electric energy, whereas if the heat is recovered otherwise, it replaces only the equivalent heat units derived from coal or oil as fuel.

The degree of utilization of the heat from combustion of the P and CO is a measure of the advancement of this process. To date this recuperation feature has had limited realization, but improved design and modifications of equipment promise great economies along this line in the near future.

The non-electric processes for production of phosphoric acid consist in principle of:

1. The fuel-fired furnace, usually considered in the form of the blast furnace, using coke as fuel and reducing agent.
2. The sulphuric-acid process, consisting in treating phosphate rock with sulphuric acid with separation of the calcium sulphate by filtration or counter-current decantation, and subsequent concentration of the resulting weak acid.

No actual figures are available on the performance of commercial units of the fuel-fired furnace for the production of phosphoric acid. However, certain theoretical considerations of fundamental principles involved show the ultimate limits of fuel economy in such operation. The thermal balance shown in Table II applies to any thermal means of reducing phosphorus from phosphate rock. The energy requirement per pound of P_2O_5 with the blast furnace charge is calculated in a modified

Table I—Theoretical Metallurgical Balance of Electric Furnace Phosphorus Production

(Per lb. P_2O_5 charged)

Charge and Products	Total Weights, Lb.	P_2O_5	Fe_2O_3	SiO_2	Al_2O_3	CaO	MgO	CO_2	H_2O	C
		Per Cent of Constituents in Charge								
Phosphate rock	....	35.58	1.50	3.50	1.00	50.00	1.00	5.50	1.92	....
Silica rock	....	....	2.00	95.00	1.00	1.00	....	....	1.00	....
Coke (reduction)	....	....	1.00	6.00	3.00	1.00	....	....	1.00	88.00
		Weight of Constituents in Charge								
Phosphate rock	2.810	1.000	0.042	0.098	0.028	1.405	0.028	0.154	0.055	....
Silica rock	0.900	....	0.018	0.855	0.009	0.009	....	....	0.009	....
Coke	0.528	....	0.006	0.031	0.015	0.006	....	....	0.006	0.464
Totals	4.237	1.000	0.066	0.984	0.052	1.420	0.028	0.154	0.070	0.464
		Weight of Constituents in Products								
Metal (ferrophosphorus)	0.061	(P) 0.015	(Fe) 0.046	....	....	....	....	....	....	....
Slag	2.548	0.064	....	0.984	0.052	1.420	0.028	....	....	....
Gases	1.567	....	....	....	....	....	....	....	....	....
P	0.394	(P) 0.394	....	....	....	....	....	....	....	....
CO	0.921	(O) 0.526	....	....	....	....	....	....	....	0.395
CO_2	0.182	....	(O) 0.020	....	....	....	....	0.154	....	0.008
H_2O	0.070	....	....	....	....	....	....	....	0.070	....
Carbon loss	0.061	....	....	....	....	....	....	....	....	0.061

Carbon Balance

	Weight, Lb.	Per Cent
Used for reducing P_2O_5	0.395	85.12
Used for reducing Fe_2O_3	0.008	1.72
Loss	0.061	13.16
Total	0.464	100.00

Coke per lb. P_2O_5 charged	0.528 lb.
Coke per lb. P_2O_5 in acid and metal	0.582 lb.
Coke per lb. P_2O_5 in acid	0.606 lb.

P_2O_5 Balance

Per cent of P_2O_5 charged to metal	3.44
Per cent of P_2O_5 charged to slag	6.40
Per cent of P_2O_5 charged to gases	90.16
Estimated loss of P_2O_5 in gases	3.00
Estimated recovery of P_2O_5 in acid	87.16
Total recovery of P_2O_5 in acid and metal	90.60

Slag Analysis (Per cent)

P_2O_5	2.51
SiO_2	38.64
Al_2O_3	2.04
CaO	55.72
MgO	1.09

Slag per lb. P_2O_5 charged	2.548
Slag per lb. P_2O_5 in acid and metal	2.812
Slag per lb. P_2O_5 in acid	2.923

balance as equivalent to 3.085 lb. of carbon (as coke).

Since all of the heat in the hearth of a blast furnace must be derived from combustion of carbon to CO, yielding 4,394 B.t.u. per pound as compared with 14,544 B.t.u. per pound for combustion to CO_2, it is obvious that only 30 per cent of the actual heat value of the coal can be usefully employed, whereas in the electric furnace not less than 85 per cent of the energy applied is effective. This follows from the fact that a reducing atmosphere must be maintained in the fuel-fired furnace.

Expressing this in another way, we see that:

3.085 lb. C per lb. of P_2O_5 = 45,000 B.t.u. (blast furnace operation)

While

the electric furnace consumes typically 2.7 kw.-hr. per pound of P_2O_5 = 9,213 B.t.u.

At the same time, in modern, efficient steam-electric generating stations, the fuel consumption is around 14,000 B.t.u. per kilowatt-hour. At this rate the electric energy required per pound of P_2O_5 corresponds to a fuel consumption in the generation plant of $2.7 \times 14{,}000$ or 37,800 B.t.u. From this analysis it is evident that greater

Table II—Theoretical Thermal Balance of Electric Furnace Phosphorus Production

(Per lb. P_2O_5 charged)
No recuperation of heat from combustion of P_2 and CO is taken into account here.

	Weight, Lb.	Factor	Heat Absorbed (—) or Generated (+) P.c.u.*
Decomposition $3CaO—P_2O_5$	2.183	514	—1,122
Reduction P_2O_5	0.936	2,572	—2,407
Reduction Fe_2O_3	0.066	1,223	— 80
Decomposition $CaO—CO_2$	0.350	451	— 157
Heat in slag at 1,450 deg. C.	2.548	525	—1,337
Heat in metal at 1,450 deg. C.	0.061	308	— 18
Heat in gases at 200 deg. C.			
P	0.394	60	— 24
CO	0.921	50	— 46
CO_2	0.182	43	— 9
H_2O	0.070	100	— 7
C to CO	0.395	2,430	+ 960
C to CO_2	0.008	8,100	+ 65
Slag formation	2.548	150	+ 382
Energy required per lb. P_2O_5 charged (net)			3,805 (2.00 kw.-hr.)
Energy required per lb. P_2O_5 in acid and metal (90.6 per cent)			4,200 (2.21 kw.-hr.)
Energy required per lb. P_2O_5 in acid (87.16 per cent)			4,365 (2.29 kw.-hr.)

Heat of Combustion of Gases†

P 0.394 x 5895 = 2323
CO 0.921 x 2430 = 2238

Total..........4561 P.c.u.

*P.c.u., pound-centigrade units, equal B.t.u. ÷ 1.8.
†A considerable part of the heat is recoverable.

fuel economy will be attained by taking the coal required for coke for the blast furnace production of P_2O_5 and converting it through steam to electric energy and using the power in an electric furnace for P_2O_5 production.

Complete discussion of all the relative factors involved is impossible in this brief paper, but the foregoing fundamental principle should have consideration in a discussion of the relative merits and economies of the two processes. When the ltimate fuel or thermal efficiency is taken into account along with relative investment, equipment, maintenance and quality of product as effecting the cost of the final phosphoric acid products, the electric furnace process as developed in its present stage appears to hold distinct advantage.

The relative economy of the sulphuric acid process and electric process depends to a degree upon the relative cost of sulphuric acid and electric power, and upon the cost of phosphate rock delivered. Table III shows the relation of power costs to sulphuric acid per pound of P_2O_5. The last three columns show the price at which electric power must be obtained to equal the cost of sulphuric acid at power consumptions of 2.75, 2.50 and 2.25 kw.-hr. per pound of P_2O_5, respectively.

Table III—Relative Costs of Sulphuric Acid and Electric Power for Phosphoric Acid Production

(Per lb. of P_2O_5 by respective processes)
Basis: 1 ton 60 deg. Bé. H_2SO_4 per ton 70% phosphate rock
Recovery of P_2O_5 in acid from rock: 90 per cent.
Then: 1 lb. P_2O_5 requires 3.472 lb. of 60 deg. Bé. H_2SO_4.

Sulphuric Acid — Cost of 60 Deg. Bé. H_2SO_4			Electric Power — Price That Can Be Paid per Kw.-Hr. to Equal Cost of H_2SO_4		
Per Ton Acid	Per Lb. Acid	Per Lb. P_2O_5	At 2.75 Kw.-Hr. Per Lb. P_2O_5	At 2.50 Kw.-Hr. Per Lb. P_2O_5	At 2.25 Kw.-Hr Per Lb. P_2O_5
$5.00	$0.0025	$0.00868	$0.00315	$0.00347	$0.00385
6.00	0.0030	0.01042	0.00378	0.00417	0.00463
7.00	0.0035	0.01215	0.00441	0.00486	0.00540
8.00	0.0040	0.01388	0.00505	0.00552	0.00617
9.00	0.0045	0.01562	0.00568	0.00624	0.00694
10.00	0.0050	0.01736	0.00631	0.00694	0.00772
11.00	0.0055	0.01909	0.00694	0.00767	0.00848
12.00	0.0060	0.02083	0.00757	0.00833	0.00926
13.00	0.0065	0.02256	0.00820	0.00902	0.01002
14.00	0.0070	0.02473	0.00893	0.00989	0.01100
15.00	0.0075	0.02604	0.00946	0.10416	0.01157

Of course, the relative conversion and investment costs must be taken into account. There is, however, the further relative consideration that the sulphuric acid process produces phosphoric acid carrying iron and aluminum phosphate in solution, whereas the electric furnace acid is substantially pure. The additional cost involved in separating the insoluble phosphates from neutralization products when soluble concentrated fertilizer chemicals are produced is an important factor. The filtration and evaporation costs in such operation are entirely avoided with the concentrated and substantially pure acid from the electric process.

Summarizing, it may be definitely stated that in selecting a process for the production of phosphoric acid, the relative economy can be determined only when all the costs from raw materials to ultimate products are taken into account. The electrothermal process, as developed at Anniston, has a definite place in the entire phosphate products industry, and through further economies, in process of development, will remain a dominant factor.

Metallurgical Uses of Natural Gas

PROBABILITY that the development of metallurgical uses for natural gas may stimulate the growth of chemical and metallurgical industries on the Pacific Coast is suggested by the U. S. Bureau of Mines, Department of Commerce. The Pacific Experiment Station of the Bureau of Mines, located at Berkeley, Calif., has recently had many requests for information concerning possible metallurgical uses for natural gas or methane. The thermodynamic investigations of the properties of metallurgically important materials being conducted at that station have been particularly useful in enabling such inquiries to be met in a helpful manner.

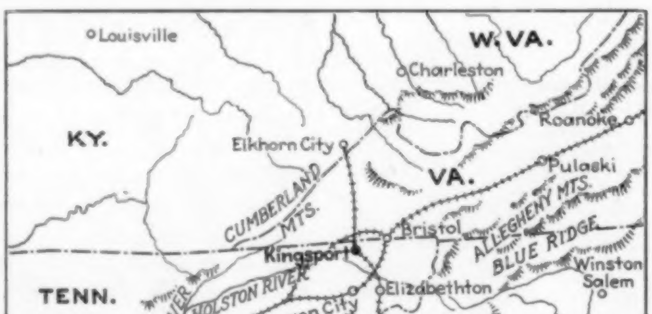
It seems possible that for strictly metallurgical or chemical uses—that is, aside from the use for direct production of power—the fields of greatest theoretical interest will be the manufacture of hydrogen for ammonia, syntheses, and the direct reduction of such oxides as zinc or iron. Although the direct manufacture of hydrogen from methane is possible, it seems that the most economic method for producing the pure hydrogen required for ammonia syntheses will be by the action of steam on metallic iron, the iron oxides so produced being again reduced to metal by the use of the natural gas.

The thermodynamic properties of methane are such as to cause it to be very efficient as a reducing agent for oxides. Although at very low temperatures methane is theoretically a poorer reducer than a mixture of the carbon and hydrogen which comprises its composition, it rapidly becomes a more active reducer at such relatively low temperatures as 600-700 deg. C.

Tennessee Eastman Corporation With the City of Kingsport in the Background

Chemical Industry Flourishes In Kingsport

TEN YEARS ago when the incorporated city of Kingsport, Tenn., was but two years old, *Chem. & Met.* described the remarkable development of its chemical industries. (See Vol. 20, No. 11, pages 565-70, June 1, 1919, and No. 12, pages 639-44, June 15, 1919.) These articles briefly told the story of how this model young industrial city had been deliberately planned and then systematically built to afford a maximum of industrial efficiency combined with all of the elements that make for civic beauty and human happiness. Incorporated March 2, 1917, Kingsport had grown to a population of several thousands by the opening of 1919 and seven important industries had contributed to its development. There was the cement and lime plant, a wood distillation plant, a tannery and tannic-acid industry, a brick plant, a pulp mill, a hosiery mill, a dyestuffs and munitions factory and a gas-shell loading plant. Today, ten years later, Kingsport has a population of more than 15,000 and is definitely laid out to serve a population of 50,000. Instead of 7 there are 15 major industries which because of their unique interrelations, their advantageous setting as regards raw materials, labor and transportation, have had a remarkable record of successful development. The munitions plant and the dyeworks with its mushroomed growth of the war period have gone, of course, but they have been replaced by larger industries with more permanent claim on the unusual physical and human resources of the city.



It is the purpose of the present brief article to comment on some of the more significant of recent industrial developments—particularly of chemical engineering interest. Tennessee-Eastman, the Blue Ridge Glass Corporation and the Holliston mills are among the industries that have been established since 1919. The Mead Fibre Company has developed greatly during this period and radical changes are in prospect for the Pennsylvania-Dixie Cement Corporation. Plans for several other new industries of even greater interest are in the offing, for it is apparent that in addition to the plants now firmly established, there are opportunities for others that can supply raw materials for, or utilize the products of, existing plants. That there is a surprising diversity of both raw materials and finished products is evident from the accompanying tabulation.

Many of the developments at Kingsport are branches of industries of national importance. In these developments, as would be expected, trained technical supervision is quite evident. This is not only true of Kingsport industries, but it is also manifest throughout the city itself; it is truly a town in which engineering skill has been brought to bear on almost every civic activity. Kingsport prides itself on this, perhaps more than any other feature of its development—that "the man who knows how" from long experience and training, has been sought to lay out plans throughout the entire development of the city. The city plan, the charter, the drainage and water systems, the school organization—all show the marked influence of the technical expert.

Products and Annual Raw Material Requirements of Kingsport Industries

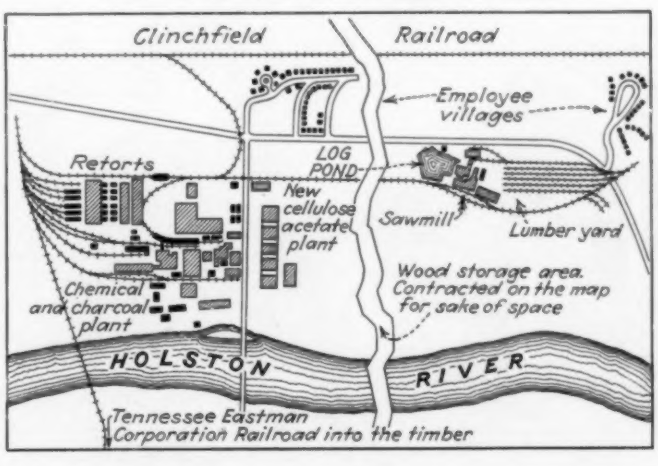
Corporation and Products	Incoming Cars of Raw Materials		Outgoing Cars of Finished Products		Total Cars
Penn. Dixie Cement Corporation. Portland cement	Limestone	5,400	Cement	6,504	
	Coal	1,500			
	Gypsum	264			
	Miscellaneous	2,340			
	Total	9,504		6,504	16,008
General Shale Products. Construction brick, face brick, wire cuts, etc.	Shale	4,000	Brick	3,800	
	Coal	600			
	Sand	24			
	Other materials	7			
	Total	4,631		3,800	8,431
Kingsport Foundry & Mfg. Co. Gray iron, brass and semi-steel castings for general job work	Pig iron	24	Castings	48	
	Coke	24			
	Sand	12			
	Total	60		48	108
Kingsport Hosiery Mills. Seamless hosiery and full fashioned hosiery	Silk and yarn	108	Hose	120	
	Dye materials	12			
	Coal	48			
	Total	168		120	288
Kingsport Silk Mills. Broad silks	Raw silk	43	Broad silk	43	
	Total	43		43	86
Borden Mills. Unbleached cotton cloth	Raw cotton	264	Cloth	264	
	Coal	48	Waste	96	
	Starch and misc.	24			
	Total	336		360	696
Rextex Hosiery Mills. Men's fancy half hose	Silk and yarn	24	Hose	24	
	Coal	12			
	Total	36		24	60
Tennessee Eastman Corporation. Lumber, charcoal, acetate of lime, methanol, methyl acetone, wood tar, other chemicals	Chemicals	9	Lumber	666	
	Coal	416	Charcoal	1,862	
	Wood	3,700	Acet. of lime	176	
	Logs	2,020	Methyl acetone	5	
	Lime	40	Wood tar	10	
	Packing supplies	26	Methanol	44	
	Misc.	26	Misc.	8	
	Construction material	33			
	Total	6,270		2,771	9,041
Holliston Mills. Book cloth	Gray cloth	192	Bleached cloth	108	
	Clay	12	Book cloth	72	
	Starch	12			
	Color	12			
	Caustic	12			
	Total	240		180	420
Kingtan Extract Corporation. Factory sole and welting leather, bark extract, liquid and powdered chestnut extract, blended extracts	Chestnut wood	3,000	Leather	156	
	Bark	1,560	Liquid extract	156	
	Sulphuric acid	12			
	Epsom salts	12			
	Corn sugar	12			
	Lime	12			
	Alkali	12			
	Coal	360			
	Raw hides	156			
	Quebracho extract	36			
	Total	5,172		312	5,484
Mead Fibre Company. Bleached soda pulp, book and magazine paper	Pulp wood	3,756	Soda pulp	1,252	
	Coal	1,560	Paper	1,252	
	Soda ash	104			
	Liquid chlorine	104			
	Lime	626			
	Bleached sulphite	313			
	Clay	78			
	Wrapper	78			
	Other materials	156			
	Total	6,775		2,504	9,279
Blue Ridge Glass Corporation. Rough, ribbed, hammered, prism, smooth and figured glass, rough, ribbed and figured wire glass, polished wire glass.	Sand and misc.	1,500	Glass	900	
	Total	1,500		900	2,400
Kingsport Press. Book manufacturers	Unprinted paper	340	Finished books	384	
	Coal	55			
	Binders all board	24			
	Box lumber	24			
	Other materials	52			
	Total	495		384	879
	Grand total	35,230		17,950	53,180

Cellulose Acetate for Films, Rayon, and Plastics

When the Tennessee-Eastman Corporation purchased its original unit and plant site from the government in 1920, it covered but 40 acres. Today the actual plant property includes a good many times this area while its timber holdings amount to some forty-odd thousand acres in Tennessee, North Carolina, Virginia and Kentucky. The industry has grown not alone in size but in the diversity of its operation and the completeness with which it is able to utilize all the products of its forests.

The primary purpose of the Eastman Kodak Company in entering the wood-chemical industry through its Tennessee subsidiary was to assure itself of a supply of certain essential ingredients used in the manufacture of photographic films—particularly, methanol and acetone. In recent years, acetic acid and acetic anhydride have become of increasing importance because of the extended use of cellulose acetate in safety films for home movies and X-ray photography. It is this development that has brought about the most recent extension at Kingsport—the new cellulose-acetate plant.

Plant Site of Tennessee Eastman Corporation



Cellulose acetate has hitherto been made by the Eastman company at Rochester, but the decision to manufacture it at Kingsport means the carrying on of these operations nearer the source of raw materials, since in addition to the necessary chemicals, cotton linters are readily available from nearby southern cities.

Included in the group of six new buildings now being erected is a new power house to supply steam and electrical requirements of not only the new plant but also of the existing wood-chemical plant, replacing the present power house. There will be three 860-hp. water-tube boilers for 450-lb. steam pressure with automatic underfeed stokers. The electrical load will be taken care of by two 1,500-kw. turbines, together with the present 500-kw. turbo-generator. Exhaust steam for process requirements will be provided at 90-lb. pressure and also at 10 lb.

When the new cellulose acetate plant gets into full production, it is expected that the entire requirements of the Eastman Kodak Company will be supplied from Kingsport and that an additional quantity will be manufactured for other than photographic purposes. This will include acetate for rayon yarns, lacquers and plastics. It is confidently expected that the new plant will be in operation early in 1930.

The Blue Ridge Glass Corporation Specializes in Producing Unusual Varieties of Building Glass

Developing New Types of Building Glass

ANOTHER Kingsport industry logically located in relation to its raw materials is the Blue Ridge Glass Corporation, which was formed in December, 1925, when three internationally known glass companies, from as many countries, pooled their processes in order to produce certain improved types of building glass. The Corning Glass Works, thus joined with the St. Gobain, Chauny et Cirey Company, of France, and the Glaceries Nationales Belges, of Brussels, to form the Blue Ridge Glass Corporation. Following a period of experimentation, the company started producing in May, 1927, and since that time has carried forward the development of at least six unusual types of building glass.

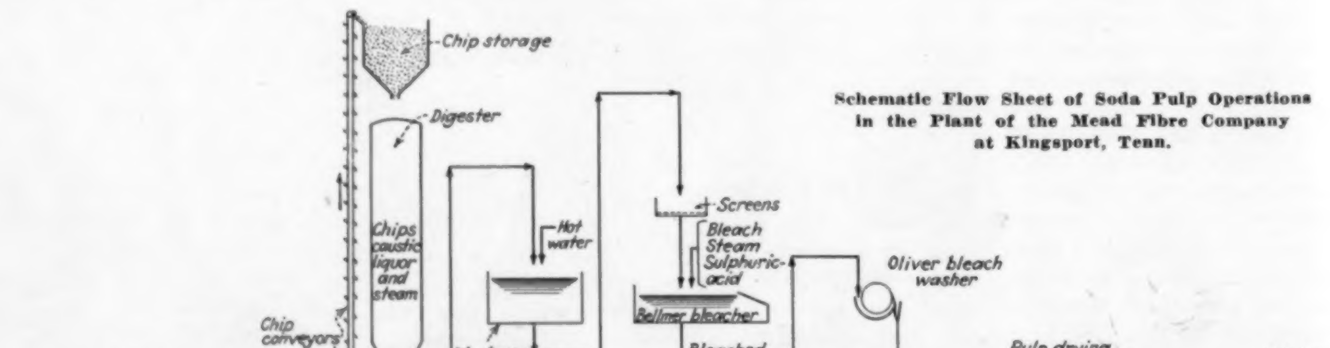
Practically all of the raw materials of the Blue Ridge plant are drawn from the surrounding country. An unusually fine deposit of silica sand comes from an apparently inexhaustible mountain of sand at Kermit, Va., on the Clinchfield Railroad only a few miles above Kingsport. Soda ash is shipped from the Mathieson Alkali Works at Saltville, Va.—about 60 miles away. Limestone comes from the quarries at Knoxville, while coal for the gas producer plant is obtained from the many mines along the Clinchfield. Virtually the only important raw material obtained from a distance is the wire for the polished wire glass—one of the principal products of the company.

Because of the nature of the work of the company in developing and perfecting manufacturing processes for new products, it has been directed from the start by technical men of broad experience in the glass industry. The manager is F. F. Shetterly, chemical engineer and for many years a glass factory executive for the Corning Glass Works. Robert Ingouf, formerly of the St. Gobain company, is treasurer and assistant manager, and J. H. Lewis, formerly of the Corning works, is chief engineer in charge of production.

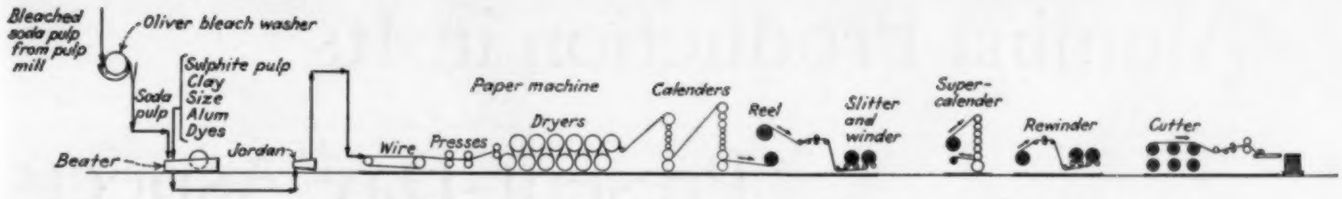
Increased Efficiency in Producing Pulp and Paper

WHEN *Chem. & Met.* in 1919 described the plant that was the forerunner of the present Mead Fibre Company, the organization was known as the Kingsport Pulp Corporation and its activities were confined to a soda pulp unit with a capacity of 40 tons per day. In 1920, when the company was taken over by the G. H. Mead interests, its capacity had been increased to 75 tons. For the next three years the plant manufactured soda pulp exclusively, shipping it principally to the paper plants of the Mead Pulp & Paper Company in Dayton and Chillicothe, Ohio. In 1923, with the establishment of the neighboring plant of the Kingsport Press, said to be the largest exclusive book manufacturing organization in the world, the Mead Fibre Company inaugurated the manufacture of book paper. A second paper machine installed in March, 1928, brought the total output up to about 20,000 tons annually. Approximately one-fourth to one-third of this production goes to the Kingsport Press and the balance is distributed nationally.

Significant of the importance of the Kingsport Press as a consumer of paper, is the fact that in August of this year 1,750,000 stitched books were completely manufactured by the Press—ninety-four railroad cars of books.



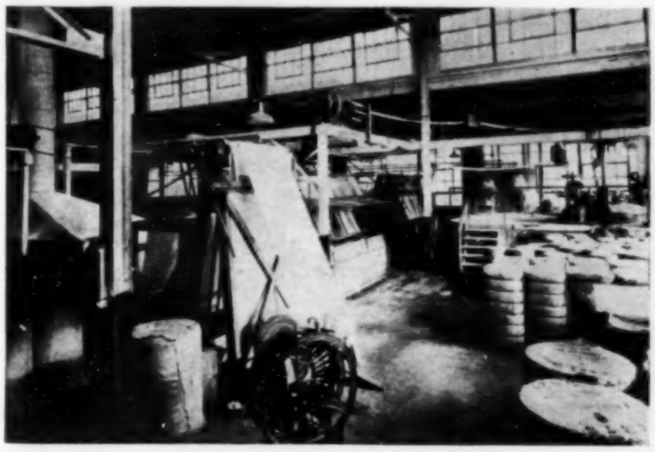
Schematic Flow Sheet of Soda Pulp Operations in the Plant of the Mead Fibre Company at Kingsport, Tenn.



Principal Steps in the Manufacture of Book Paper at Kingsport from Soda and Sulphite Pulp

In the manufacture of pulp the Mead Fibre Company consumes about 160 cords of wood per day—all of which is obtained from timber tracts of Tennessee and adjacent states. As in the case of the glass company, it is able to draw most of its raw materials from nearby sources with the exception of liquid chlorine which is obtained from Niagara Falls, N. Y., and the bleached sulphite pulp imported from Canada and Europe.

The various steps in the manufacturing operations of the Mead company are indicated in the two flow sheets on this and the preceding page. In the early days of the Kingsport Pulp Corporation, its operations were controlled from a laboratory employing but one or two technical men. As the plant has developed the number of technically trained men has increased to more than a dozen. The result has been that the output has been increased without additional personnel or radical changes in equipment.



Bleaching Cotton Cloth for the Manufacture of Book Bindings

JUST as the production of book paper was stimulated by the requirements of the Kingsport Press, another new industry, the Holliston Mills of Tennessee, owes its origin to the demand for book cloth. Established in January, 1927, as a branch of the parent Massachusetts company, the Kingsport industry quickly developed its manufacturing processes in converting the gray cotton cloth of the Carolinas to the variety of dyed and embossed bindings demanded by modern book publishing firms. Briefly these processes consist of bleaching the cloth with hypochlorite solution, dyeing it the proper shade in the dyeing machine, incorporating the necessary sizing and fillers, and finally running it through calenders to give the desired finish or lustre. If embossed cloth is desired, it goes from the calender to the engraved steel roll of the embossing machine.

OLDEST among the Kingsport industries is the cement plant, which began manufacture in 1911, six years before the present city was incorporated. For many years it played an important part in serving the rapidly mounting requirements of the territory. For most of the present year, however, there has been a general curtailment of cement production all along the Atlantic seaboard, due largely to the importation of foreign cement. The Kingsport plant was shut down entirely during this period and other Southern plants of the Pennsylvania-Dixie corporation were operated at reduced capacity. On Oct. 8, 1929, it was announced by officials of the corporation that the Kingsport plant was to be reconstructed immediately and operations renewed by the opening of the new year. With the installation of new equipment, the plant will eventually be converted over entirely to the wet process, which appears to be admirably suited to the setting and local conditions surrounding the plant.

It must be apparent that this sketchy picture of Kingsport chemical industry shows only the barest outlines of some of the important developments now under way. It does, perhaps, indicate something of the promise that the district holds for future growth. Chemical engineers will watch with interest the culmination of present plans for building Kingsport as a center for the coordinated development of an even larger group of interrelated chemical engineering industries.

New Construction Under Way at Kingsport

Here the Eastman Kodak Company through its Tennessee subsidiary is building a cellulose-acetate plant. It is expected that this will not only supply the company's requirements in the manufacture of the safety motion picture and X-ray films but will produce an additional quantity available for rayon yarns, lacquers, and plastics. The plant will be in operation in 1930.

Alumina Production in Its Present-Day Aspects

By Junius D. Edwards

AND

Ralph B. Mason

Aluminum Company of America
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As the raw material for aluminum, alumina is always a focal point of chemical engineering interest. With its ramifications among the important industries of the South, alumina production is a subject singularly pertinent to the present issue of Chem. & Met. The country's bauxite supply comes from the South, chiefly from Arkansas. Some of the most important experimental work of the Aluminum Company was carried out at its Baden, N. C., plant, while at Alcoa, Tenn., is one of the largest aluminum producing plants and rolling mills.

In the present article the authors discuss the alkaline methods of alumina production. A second article, to appear in December, will take up acid processes and high-temperature "dry processes". It is possible that one of the latter, the dry process as now used at the Arvida plant, will eventually replace earlier methods as the cost of electricity is reduced.—EDITOR.

ALUMINUM is the most widely distributed of the metals, and material containing 10 to 35 per cent aluminum oxide can be found in great abundance the world around. However, it is not economical to extract aluminum from these lean ores while bauxite carrying 50 to 60 per cent of alumina is generally available. Nevertheless, hosts of inventors have worked on processes for the extraction of alumina from clay, feldspar, alunite and other aluminous materials without any commercial result. While it is possible to extract and purify the alumina from clay, yet the cost of chemicals, energy and labor makes the procedure impractical from a commercial standpoint at present.

When alumina is converted into aluminum (e.g., by electrolysis) most of the associated impurities are likewise reduced to form metals or metalloids which alloy with and contaminate the metal. The ore of aluminum must therefore first be treated so as to eliminate substantially all of the impurities. Purified alumina suitable for the production of aluminum usually contains a total of less than 0.1 per cent of the oxides of iron, silicon and titanium and is a highly refined product. The purification is a relatively expensive process, and as it takes about two pounds of alumina to produce a pound of aluminum, the cost of the alumina is an appreciable item in the cost of aluminum. This is the reason for the great interest displayed in processes of producing pure alumina.

In the commercial production of alumina from bauxite, the general practice is to convert alumina by reaction with alkali into sodium aluminate, which is readily soluble in water. The sodium aluminate solution is then filtered off and the residue containing the iron, silicon and titanium of the bauxite is thrown away. The solution containing the alumina is treated so as to precipitate pure aluminum hydrate, which is separated, and the alkali in the solution is returned to the process. The aluminum hydrate is washed and finally heated to a high temperature to drive off all the water and convert it into pure dry aluminum oxide (Al_2O_3) which is ready to be used in the production of aluminum.

The alumina processes may be broadly divided into two classes: alkaline and acid. The Bayer process is the typical alkaline process. Briefly, we may say that iron causes no trouble in alkaline processes, ferric oxide being substantially insoluble in alkali solutions (except sulphides). Iron is thus easily and cheaply eliminated in the "red mud," and practically all of the small amount of iron oxide in the precipitated aluminum hydrate is due to mechanical contamination (incomplete removal of the "red mud" in filtration, rust from pipes and tanks, etc.) and not to the chemical process. Silica, on the other hand, is always attacked by the alkaline processes and its elimination is often troublesome, usually more or less incomplete, and involves a loss of alkali and generally also a loss of alumina. Consequently, alkaline processes require a bauxite low in silica, while iron and titanium oxides are merely inert diluents, except for processes involving fusion or fritting with alkali. In these, iron oxide is advantageous because of its ability to causticize some soda, but titanium oxide may cause some loss of alkali.

Acid processes, to be described in a subsequent article, always dissolve more or less of the iron, but most of them do not dissolve the silica. Titanium is likely to be partly dissolved. Any gelatinous or colloidal silicic acid formed by acid attack on clay can be readily and quite completely removed, but the iron salts are so closely related to the aluminum salts in their chemical

This article, in greatly condensed and somewhat modified form, is taken from the forthcoming book, "The Aluminum Industry," by J. D. Edwards, F. C. Frary and Zay Jeffries, which is being published by the McGraw-Hill Book Company.

behavior that a complete separation is practically always difficult and expensive, and in most cases commercially impossible. From their nature, therefore, the acid processes are best adapted to the treatment of ores low in iron, such as kaolin, feldspar, alunite, leucite, or the comparatively rare deposits of white bauxite. The relatively low alumina content of these ores (except the white bauxite), however, puts these processes under a serious economic handicap.

Both alkaline and acid processes involve digestion and extraction of alumina in aqueous solution. A third group of processes makes use of a first step at high temperature wherein the impurities are reduced to the metallic state for separation from the alumina; or the alumina may be converted into nitride or other compound. These "dry processes" will be discussed in a second article.

Bayer Process—There are two general procedures employed to produce the sodium aluminate solution. In the Bayer process, which is the one most widely used, the bauxite is digested under pressure with hot sodium hydroxide to form a solution of sodium aluminate. The alternative procedure is to heat the bauxite with sodium carbonate in a furnace or rotary kiln to form solid sodium aluminate. The sodium aluminate can then be leached out and the alumina recovered from the solution.

The sodium aluminate formed by the solution of alumina in caustic soda is generally ascribed the formula $NaAlO_2$. The iron oxide of the bauxite is insoluble in the sodium hydroxide solution and aside from increasing the bulk of the insoluble residue, which must be filtered and thrown away, has little effect on the process. The silica content of the bauxite is, however, very important, since it is the cause of serious losses of both soda and alumina. During the digestion there is apparently formed an insoluble sodium aluminum silicate which carries both soda and alumina into the "red mud," as the bauxite residue is called. With increasing content of silica in the bauxite, both soda and alumina losses increase.

Experience indicates that for every pound of silica in the bauxite, 1.1 to 2 pounds of alumina and 1 to 3 pounds of soda calculated as sodium carbonate are lost. The soda loss appears to vary considerably, depending on the character of the bauxite which is being digested and the conditions of digestion. It is quite essential, therefore, in selecting ore for the Bayer process to limit the silica to as low a figure as circumstances warrant. In America, bauxites are used which carry as high as 7 per cent silica; while in Europe, where a relatively large supply of low-silica bauxite is available, the bauxites employed usually contain less than 5 per cent silica. In selling bauxite to the aluminum industry, it is commercial practice to charge the producer a penalty for each unit of silica in excess of some stated amount, such as 3 per cent. Titanium oxide is also said to combine with soda to form insoluble sodium titanates and still further increase the soda losses. In view, however, of the refractory character of most titanium minerals, there is some question as to the extent of such a reaction.

Preparatory to the digestion process, the bauxite is dried and ground. The drying is necessary in order to permit the grinding of the material to a fine powder. Fine grinding (80-100 mesh) is essential in order to secure efficient extraction of the alumina. The drying

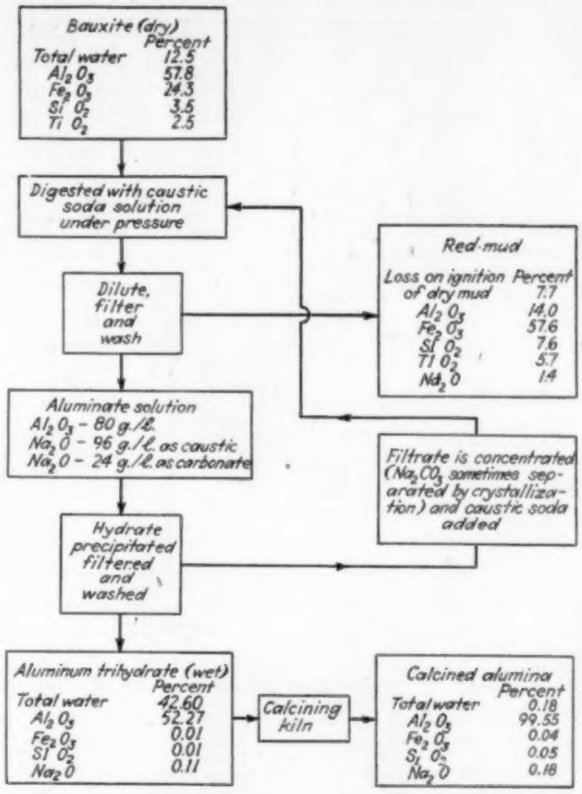


Fig. 1—Bayer Process as Carried Out at One Plant

ordinarily employed merely removes the free water of the bauxite but leaves the combined water, or water of hydration. However, Ullmann states (Ullmann, "Enzyklopädie der Technischen Chemie," Vol. 1, p. 312) that it has been the practice at some plants to calcine the bauxite at temperatures of 350 deg. to 400 deg. C. before grinding. This calcination is said to have a beneficial effect in destroying organic matter such as humus acids, which dissolve and accumulate in the alkali solutions used for digestion. (Hall, C.M. U.S. Pat. 663,167, Dec. 4, 1900; Br. Pat. 14,573 of 1900; Ger. Pat. 138,219, Jan. 3, 1903.) It may have the disadvantage, however, of rendering the alumina less readily dissolved. (Phillips, W.B. and Hancock, J., *J. Am. Chem. Soc.*, **20**, 1898, p. 209.)

In the digestion of bauxite with sodium hydroxide, the ideal aimed at is to dissolve as much as possible of the contained alumina in the shortest possible time and simultaneously produce a solution from which a maximum amount of alumina can be precipitated per unit of volume. Increasing the temperature of the solution and the concentration of sodium hydroxide increases the amount of alumina which can be dissolved. However, the more concentrated the alkali solution, the more alumina it will retain at the end of the precipitation cycle, and the greater the difficulties experienced in its filtration. Filtration is usually carried out in presses using heavy cotton cloth over steel frames, and the filter cloth shows excessive deterioration when the hot alkali is too concentrated. Under such conditions it is customary to dilute the solution before filtration. All of these factors require a nice balance in an efficient process. Bayer recommended digesting at 160 to 170 deg. C. for a period of 1½ to 2 hours. An excess of soda over the 1 : 1 ratio of Al_2O_3 to Na_2O is required in order to hold the alumina in solution during the filtration. Bayer recommends that the ratio of Al_2O_3 to Na_2O in the aluminate solution should be about 0.55.

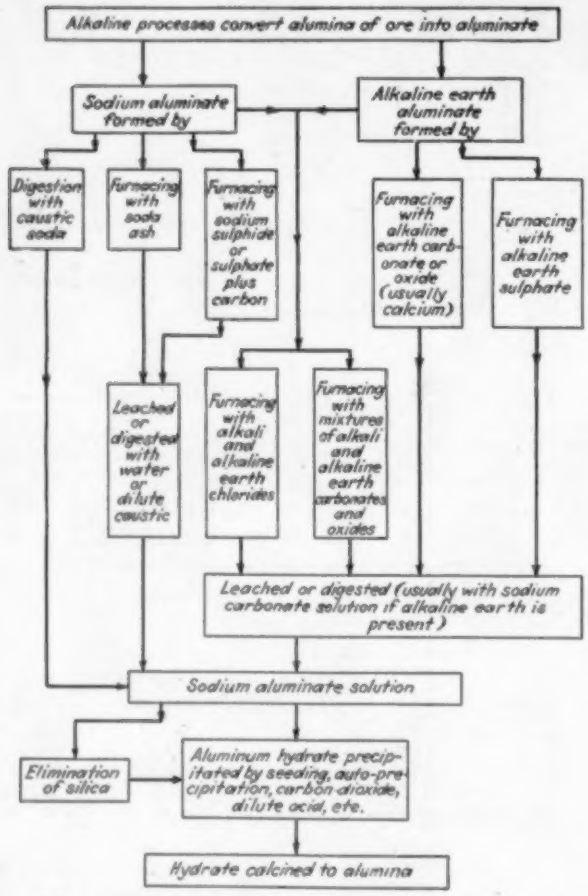


Fig. 2 — Common Variations of Major Alkaline Processes

In a recent British patent to Finkelstein (Finkelstein, A., Br. Pat. 248,746, July 4, 1927) the original Bayer procedure using solutions above 1.4 in specific gravity has been modified and a solution of sodium hydrate of specific gravity not greater than 1.36 is used to digest the bauxite at 170 deg. C. The use of weaker solutions of sodium hydroxide for certain bauxites was, however, common practice long before Finkelstein's patent. The digestion is carried out in steel digestors, heated by steam under pressure and provided with some device for stirring or agitating the charge. When digestion is complete, the charge is pumped to filter presses where the hot aluminate liquid is separated from the residual "red mud." The filter cake is washed and the first portions of the wash water are added to the concentrated aluminate solution.

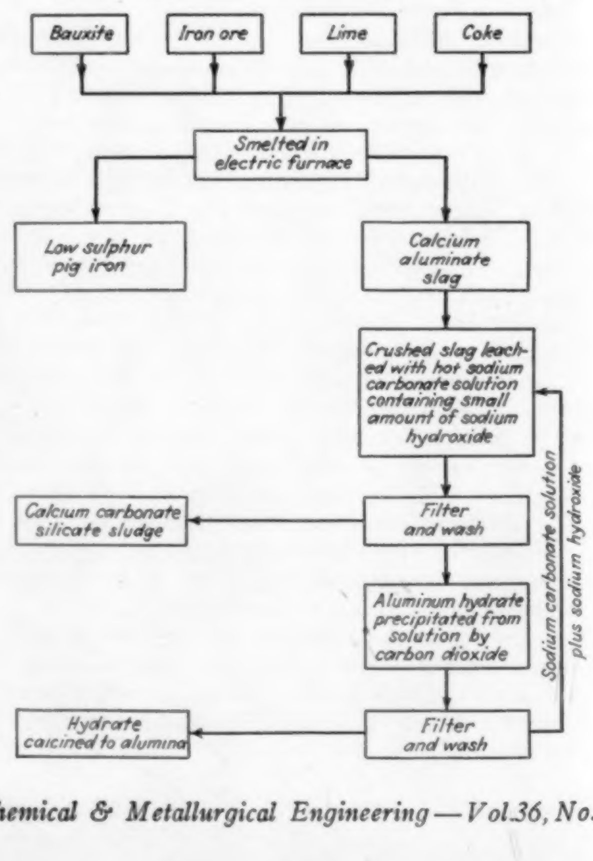
The aluminate solution is then pumped to the precipitating tanks where it is mixed with a "seed" charge of aluminum hydrate from a previous cycle. The mixture must be continually agitated and gradually cooled under conditions which permit the formation of coarsely crystalline aluminum trihydrate. Ullmann states that the most favorable range of temperatures for precipitation lies between 25 deg. and 35 deg. C. The amount and particle size of the seed charge added, the rate of cooling, degree of agitation, and the like, should be such as to minimize the production of extremely fine and powdery crystals of aluminum hydrate which would be difficult to calcine without excessive dust loss and which would later cause excessive loss by dusting when the alumina is thrown on the electrolytic cells. Bayer states that the ratio of alumina to soda (Al_2O_3 to Na_2O) should be as low as 1 to 6 at the end of the precipitation cycle. The precipitated alumina is finally filtered off or otherwise separated from the solution (e.g., by continuous settling; see Sherwin, R. S., U. S. Pat. 1,314,709, Sept. 2, 1919), washed, and sent to the calciners. There the hydrate is heated in rotary kilns to a temperature above 1,000 deg. C. in order to convert it into anhydrous alumina suitable for use in the electrolytic reduction process. The solution contains appreciable quantities of alumina and the soda; it is concentrated by evaporation, and after the addition of more sodium hydroxide to bring it up to the required strength it is used for the digestion of a new charge of bauxite. Some sodium carbonate may crystallize out of the liquor during evaporation if the concentration is high.

In Fig. 1 is shown a diagram illustrating the main steps of the Bayer process as practiced at one plant. This diagram includes typical analyses giving the composition of the raw materials and products at various steps in the process. With other types of bauxite and other operating conditions, as well as with normal variations at this plant, substantial differences in the composition of the various materials will be observed. However, for the purpose of illustration these data may be taken as typical.

Other Alkaline Processes—From 150 to 200 alkaline processes or the extraction of alumina have been patented; most of these, of course, are merely minor variations of older procedures. The chart of Fig. 2 gives in outline the steps employed in the alkaline processes and indicates the most common variations. For example, instead of first forming sodium aluminate, an alkaline earth aluminate may be formed by furnacing the aluminous ore with an alkaline earth carbonate or oxide. By leaching the reaction product with sodium carbonate solution, a solution of sodium aluminate is formed and the alumina may be recovered by standard procedures.

A practical process of this type is that of Prof. Harold Pedersen (Pedersen, H., Br. Pat. 232,930, June 14, 1926; Fr. Pat. 596,400, Oct. 22, 1925). Pedersen

Fig. 3—Pedersen Process as Employed in Sweden



smelts a mixture of iron ore, coke, lime and bauxite or other aluminous material to produce a molten calcium aluminate slag containing 30 to 50 per cent of alumina and only 5 to 10 per cent silica. Low-sulphur iron of a high grade is produced as a byproduct. The alumina in the slag can be extracted by means of a sodium carbonate solution which forms insoluble calcium carbonate and soluble sodium aluminate. Pedersen (Pedersen, H., U. S. Pat. 1,618,105, Feb. 15, 1927; Br. Pat. 252,399, June 9, 1927; Fr. Pat. 616,395, Feb. 1, 1927; Can. Pat. 269,220, Mar. 22, 1927; Norw. Pat. 44,305, Aug. 15, 1927) finds that a 3 to 8 per cent solution of sodium carbonate containing about 0.3 to 0.8 per cent sodium hydroxide can be effectively used for extracting the calcium aluminate slag. Commercial operation of this process began in 1928 at Hoyanger, Norway.

Calcium aluminate slags of the type used by Pedersen have been satisfactorily produced in a blast furnace by Joseph, Kinney and Wood, of the U. S. Bureau of mines (Joseph, T. L., Kinney, S. P., and Wood, C. E., A.I.M.E. *Tech. Pub. 112,* 1928), in co-operation with the Research Bureau of Aluminum Company of America.

Improved Naval Stores Made With Steam Still

Remodeling of fire stills is practicable and affords superior products

By F. P. Veitch and J. O. Reed

Bureau of Chemistry and Soils, U. S. Department of Agriculture, Washington, D. C.

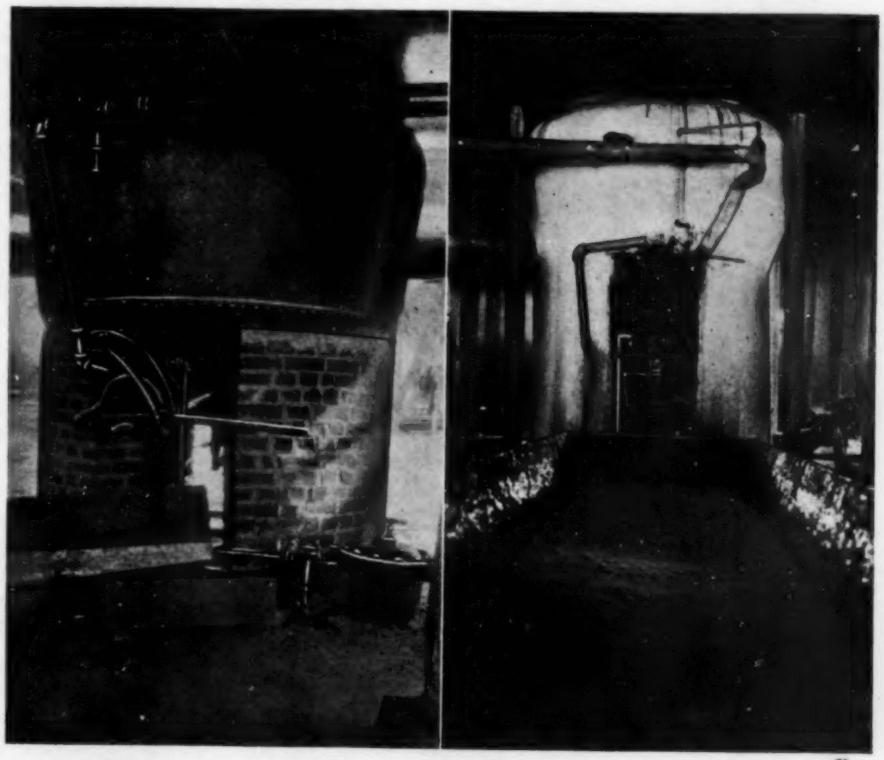
NAVAL STORES products of superior quality can be regularly marketed from gum turpentine plants if steam-heated stills are used. The steam still has certain advantages over the fire still that make it superior to the latter. Better grades of rosin together with maximum and uniform yields of turpentine can be made, with less fuel. More charges can be run per day. During the past season two 25-barrel stills have been found adequate to handle more than 500 barrels of "dip" per week, replacing three 25-barrel fire stills. The fire hazard and consequently the insurance cost are much less with the steam still than with the fire still.

The remodeling of existing fire stills on an economic basis has, therefore, been an important problem in the naval stores work of the Bureau of Chemistry and Soils of the U. S. Department of Agriculture. Plans and specifications for remodeling the existing type of fire still have been prepared by the Bureau as a result of its studies conducted in co-operation with a number of the naval stores producers of the South. The results obtained in at least nine plants have been so favorable as to warrant a general recommendation for this type of remodeled still for plants which distill an average of 150 barrels or more of crude gum per week.

The steam still of the type which is suggested is not in any sense an adaptation or copy of the stills used for turpentine in other countries, but simply a modification of the American fire still along well-established, simple lines. It is designed in such a manner that it can readily be constructed from the fire still which has been used for many years in this country. The concave bottom of the fire still is hammered into a funnel shape, and steam coils and a live steam sparger or injector are fitted inside the still. The same worm, rosin strainers, and vats which are used with the fire still can be used with the steam still. A horizontal high-pressure fire-tube boiler capable of operating continuously at 125 pounds (preferably at 150 pounds) gage pressure is required; the common upright boiler generally used for turpentine stills is *not* suitable. A 25-barrel still requires a boiler of 50 boiler horsepower.

A superheater for conditioning the steam for satisfactory distillation has been designed by the Bureau and is adapted for use in the setting of a horizontal fire-tube boiler. Steam traps, gages, and the necessary piping and valves to connect the boiler with the coils and live steam sparger are required. The plans and specifications prepared by and available from the Department of Agriculture should be strictly adhered to in the construction of this still. Stills not made in accordance with the specifications of the Department have caused considerable trouble and expense, whereas those that were constructed strictly according to the plans and specifications have given complete satisfaction wherever they were built.

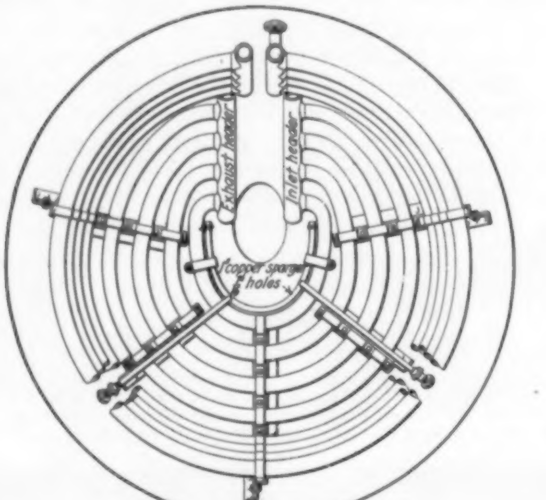
Department of Agriculture's Steam Still Appears at Left, Installed but Not Yet Covered With Insulation. Note Tail Gate and Hammered-Down Bottom. View at Right Shows Completed Still With Rosin Vat in Foreground



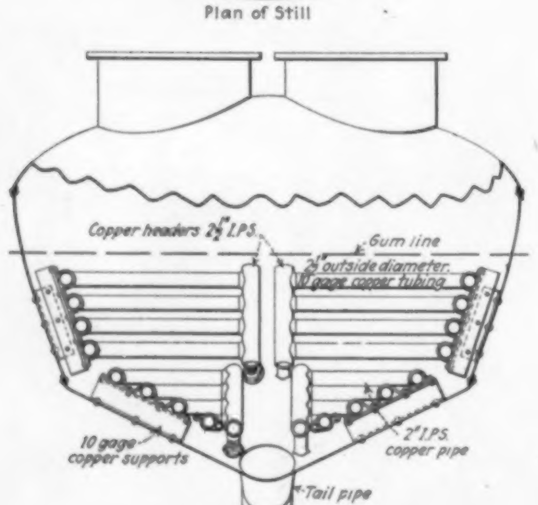
The chief expense of converting a fire still into a steam still is the cost of the boiler and its installation. A 50-hp. boiler with accessories can be bought for about $1,000. This does not include the cost of installing. The superheater can be built for about $150. Quotations from $575 to $775 have been obtained for changing a 25-barrel fire still into a steam still in accordance with Department of Agriculture plans and specifications. Piping, still mounting, insulating material, gages, traps, and so forth, cost about $375 making the total expense approximately $2,200. These figures do not include the cost of installation. Definite quotations for all necessary equipment should be obtained from still builders. It must be clearly understood that the cost will vary somewhat in different parts of the producing belt and that the Department can not be expected to give exact estimates. The figures indicated are merely approximations.

Charging, skimming, discharging, and straining are all done in practically the same way with the steam still as with the fire still. The coils are so placed that they do not interfere with skimming or discharging. The closed steam coils supply the heat required to distill off the spirits and produce the rosin. Live steam injected into the bottom of the still takes the place of water in bringing over the spirits. Operating the steam still is very much simpler than operating the fire still, and uniform results are more easily obtained.

Two Steam Stills in This Gum Turpentine Plant Now Do Work Formerly Done by Three Fire Stills. They Produce Better Rosin and Higher Yield of Turpentine



Plan of Still



Sectional Elevation

25-Barrel Steam Still Designed by Department of Agriculture for Turpentine Distillation, Shown in Plan and Elevation

This drawing is condensed from the Department's drawing, U-23, prepared by the Chemical Engineering Division of the Bureau of Chemistry and Soils. Both drawing and specifications are available from the Bureau.

The Department will give producers installing steam stills advice and assistance in designing, constructing, and operating their plants, so far as possible.

A public service patent on the steam still designed by the Department has been applied for. This patent will grant the privilege of manufacturing and operating the still without payment of royalties.

Oil Hydrogenation Plants Being Built

IN THE June, 1929, issue of *Chem. & Met.* it was reported that the Standard Oil Company of New Jersey was commencing construction on the first of two plants for the hydrogenation of cracked residues. Experimental work was carried out at Bayway, N. J., and at the Baton Rouge refinery of the Standard Oil of Louisiana. Commercial units are now being built at Baton Rouge and at the Bayway, N. J., refinery of the company. It has been further announced that an installation of the process will be made at the Baytown, Texas, refinery of the Humble Oil & Refining Company, also a subsidiary of Standard Oil of New Jersey.

It is claimed that cracked residues from the ordinary temperature-pressure cracking units can be converted 100 per cent into gasoline by this process. Pressures of 3,000 lb. upward are used. In one of the company's patents (E. P. 308,297, March 21, 1928, reviewed by George A. Burrell in the Oct. 10 issue of *Oil and Gas Journal*) the oil is subjected to a pressure of 50-100 atmospheres and a temperature of 750-850 deg. F. and agitated with hydrogen. The process may be batch or continuous, in a vessel having non-reactive steel alloy surfaces. Metal oxides or other catalysts—e.g., a mixture of 9 lb. of chromium oxide with 1 lb. of molybdenum oxide—should be suspended in the oil. The cracked, hydrogenated and desulphurized product is fractionally condensed, treated with 10-50 per cent of 98 per cent sulphuric acid or with fuming sulphuric acid, then with caustic soda solution, blown dry, and filtered through fullers earth. In a second example, oils containing large amounts of unsaturated compounds—e.g., cracked oils—are hydrogenated without cracking at 650 deg. F. and 100 atm.

This work of the Standard Oil of New Jersey follows the I. G. Farbenindustrie's work previously mentioned in *Chem. & Met.* and results from an agreement with the latter concern whereby the American rights to the processes have been secured.

Gas Engineering Holds Floor at Association Convention

A.G.A. sessions at Atlantic City, Oct. 14-18, report progress during past year in technologic phases of gas manufacture, with interest centered on water-gas, carbonization, gas-enrichment, and gas-dehydration

Editorial Staff Report

CHEMICAL ENGINEERING developments continue to furnish an important part in the advances of the gas industry. And, surprisingly, although water-gas production is declining slightly, a substantial part of the new developments lie in the field of either manufacture or modification of water gas. Fewer, though perhaps no less fundamental, changes are being made regularly in the fields of coal carbonization and oil-gas production.

The recent convention of the American Gas Association, at Atlantic City, demonstrated that the methods of automatic gas manufacture which were described in *Chem. & Met.* (Vol. 35, No. 11, p. 665, 1928) are continuing to grow in importance and to prove their merit. Practically all the important mechanical engineering advances summarized at this convention have to do either with mechanical charging, mechanical clinkering, or automatic control of machines. A subdivision of the water-gas committee, which reported on this subject affords new data confirming the extent to which these mechanisms are supplanting hand labor increasing both output and plant efficiency, with consequent large reduction in gas-making operating cost.

Variations in the methods of water-gas making, reported at the convention, include tests on an oxygen-blast producer, the enrichment of water gas with petroleum cracking-still vent gases, the production of low-gravity water gas, and an interpretation of the possibility (or impracticability) of the use of water-gas machines during off-peak seasons to supply gas for synthetic chemical plants.

A chemical group working under the chairmanship of A. C. Fieldner reported a further analysis of the possibilities for using off-peak water-gas equipment and concludes that the prospects are this year no more favorable than a year ago. This group points out that synthetic ammonia production has advanced so rapidly and the building of methanol plants has been so successful that neither of these fields is longer open to the public-utility gas man as an outlet for his off-peak blue gas.

Their conclusions regarding the manufacture catalytically of gas enrichers is hardly less discouraging. They point out that the alcohol or ether type of enricher has no advantage over the methane or hydrocarbon type and that the latter group of products can be made only with the sacrifice of a large percentage of the thermal efficiency of the raw-material gas. This last factor seems to preclude synthetic methane production from the field of practicable products from off-peak water gas, the committee concludes.

Similar negative conclusions are indicated by the subcommittee which has considered the use of oxygen or oxygen-air mixtures for gas-machine blast. This group concludes that the manufacture of oxygen at any price which would make its application in gas making commercially feasible seems highly improbable at the present time. This committee does, however, report further interesting works-scale experiments made by the General Electric Company on an experimental producer. Using oxygen-air blast the results obtained were: Oxygen consumption, 335 cu.ft.; air consumption, 142 cu.ft.; solid fuel, 23.5 lb.; and steam, 62.6 lb. per M of 285 B.t.u. blue gas produced. With straight oxygen blast the materials consumed were: Oxygen, 277 cu.ft.; solid fuel, 23.5 lb.; and steam 59.8 lb. per M of 297 B.t.u. gas produced.

The results of manufacture of low-gravity water gas and a listing of suitable bituminous coals for water-gas making are now available to interested engineers through the printed sub-committee reports which deal with these phases of the water-gas business. These reports have previously been summarized in *Chem. & Met.* in connection with the production conference of the association, but full data have not hitherto been available. Similarly, engineers who are concerned with water-gas or producer-gas plant operation in industrial works will welcome the sub-committee reports, now printed: on steam decomposition in water-gas sets, A. E. Lockwood, chairman; producer-gas sub-committee report, C. R. Locke chairman; and mechanical mixing of gas, E. A. Munyan, chairman.

PROPANE AND BUTANE enrichment, or propane and butane vapor supply for city gas received further serious consideration at the convention in three separate reports. The possibility of competition of these hydrocarbon byproducts of natural gasoline with city gas was recognized by the rate structure committee of the association through the findings of one of its sub-committees.

This group urged that industrial gas rates be so fixed that they may be successfully competitive with propane and butane in order that the large industrial load which the gas industry desires may not be taken from it by direct sale of these petroleum products from the refining industry to industrial customers.

The technology of utilizing these hydrocarbons in the gas industry itself was considered from a variety of points of view by a special sub-division of the water-gas committee. This group presents in its printed report very full data on the experience which has been had in using these hydrocarbons at Davenport, Iowa; Louisville, Ky.; Sheridan, Ind.; Poughkeepsie, N. Y.; Haverhill, Mass., and elsewhere. There are four major methods of use described: as a carburetting material in place of gas oil; as an enricher to aid in meeting peak loads; mixed with air (in non-explosive proportions) directly as city gas; and for enrichment to make up heat losses suffered by a gas during compression and transmission.

The sub-committee report referred to is supplemented by a very complete technical and economic analysis of the way in which Louisville has combined butane enrichment with the manufacture of low-gravity water gas to meet the serious peak-load problems of that community.

Carbonization developments of the past year have included relatively few radical or new processes. This fact is evident both from the general character of the carbonization committee report and from the sub-committee findings of the group dealing with "new coal processing methods." It is pointed out that none of the low-temperature processes which have previously been considered by this committee have advanced radically during the past year, although some new plants have been built and are now in experimental large-scale operation.

PRACTICALLY all new construction work described by the sub-committee of plant-building company-representatives covered installations that follow rather closely along conventional lines. It is evident from the committee report, however, that there is continuous increase in the extent to which completely mechanized plants are becoming recognized. A careful analysis of this development for horizontal-retort plants, which include the principal remaining hand-operated plants, is presented through the sub-committee by F. G. Curfman, whose results show a substantial saving, of nearly 5c. per M, even for a small works, in a completely mechanized as compared with a partially mechanized retort house.

Continuing its research on the fundamental factors affecting the gas- and coke-making properties of coal, the sub-committee on this subject has during the past year had an extended series of experiments conducted at the U. S. Bureau of Mines in Pittsburgh. From this work the committee concludes that small-scale tests, using 70 to 90 lb. of coal per charge, are capable of giving accurate quantitative data on yields of products and on the quality of all products save possibly the structure of the coke. The committee further indicates that the test yields, within the range of experimental uncertainty, are practically identical with those obtained in industrial practice and do not require the customary "correction factors" which are usually needed to convert small-scale test data into commercial-scale yields.

THE CONTRIBUTIONS of chemical engineering to the gas industry were reviewed at the convention by Prof. A. H. White, of the University of Michigan, in an address before the technical section. Using as his example the phenomenon of heat transfer, Professor White showed how fundamental physico-chemical data and chemical engineering methods may be adapted to studies of carbonization, gas condensation and cooling, and like processes which are the every-day job of the gas engineer. He emphasized the importance of the film effect in such industrial operations and showed how empirical conclusions are at times right and at other times wrong, due to a failure to properly appraise the underlying physico-chemical relationship involved. As an example of the erroneous conclusions sometimes drawn from empiric observation he cited the old belief that it was improper to "shock" a gas during cooling.

In his further discussion of scrubbing, water-gas making, and similarly important parts of the industry's technical problems, Professor White expounded the theory of fundamental study of the unit operations involved. He pointed out that further development of the industry is likely to require more radical change in the future because the present processes have more or less reached their limit of efficiency and advance through merely slow and small change based on cautious practical experimentation. He suggested, for example, the necessity of considering processing of coal in the powdered form, possible interlock of the gas and power-plant problems and materials, and the possibility of working up byproducts, such as tar and heavy oils, through entirely new types of reactions, including catalytic.

DEHYDRATION of gas at the works before distribution is a possibility which has had serious commercial consideration over a period of several years in Great Britain. Charles Cooper, of W. C. Holmes & Company, Ltd., Huddersfield, England, summarizes the British experience of more than a dozen works which now are equipped to dehydrate more than 50,000,000 cu.ft. of city gas per day. He pointed out that there were numerous theoretical advantages in elimination of internal corrosion of the distribution system, better operation of governors, longer life for meters, and customer advantages, all of which seem to be generally confirmed by the experience on city-wide scale of companies in his country. The major operating difficulties encountered incident to loss of volume and the production of dusty gas have been met with almost complete success by these concerns.

The committee of dehydration of gas, under the chairmanship of F. W. Sperr, Jr., reported on its investigations in the United States, including further details of the practical results obtained at Grand Rapids, Mich., the first works where city-wide gas drying has been practiced in this country. The cost figures reported for Grand Rapids indicate a range from 0.38c. to 0.53c. per M, according to winter and summer conditions. The main seasonal difference was occasioned by the requirement of 0.05c. per M for cooling water and 0.10c. per M for additional steam cost in the summer time above winter expenses. The average for this plant, which daily dehydrates 5,000,000 cu.ft. of gas, was a trifle under 0.5c. per M for the year.

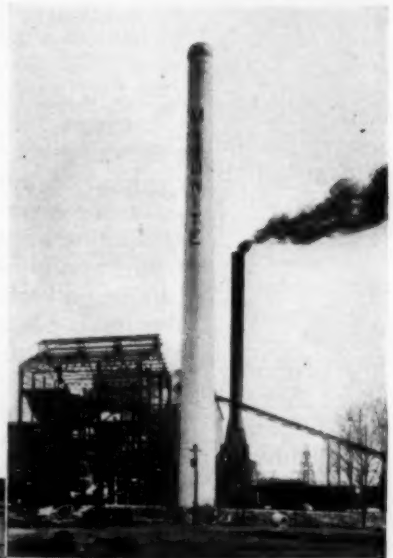
The sub-committee concludes that for typical American conditions the total cost of dehydration, including naphthalene removal, should not ordinarily exceed 0.75c. per M cu.ft. of gas. They believe that this increased cost is much more than offset by decreased corrosion, increased meter life, bettered operation of governors and other distribution units, as well as other incidental advantages to the company practicing gas drying.

A New Southern Industry Develops

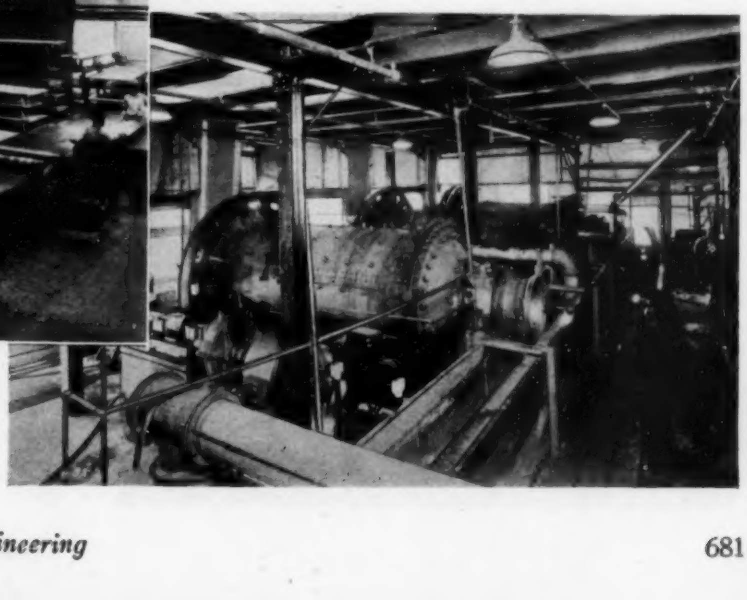
Above is a view of the fuel conveyor carrying waste wood from the sawmill to the plant. Carloads of waste wood are being unloaded in the foreground. At the right are the two main mill buildings. One building is 76 ft. wide and the other 100 ft. Additions 180 ft. long are now being added to each.

JUST three years ago the Mason Fibre Company, now the Masonite Corporation, commenced operations at Laurel, Miss., manufacturing insulating lumber and a densely pressed fiberboard from waste wood, using the process developed by W. H. Mason. The process was described in *Chem. & Met.* in June, 1927.

THE process consists in hogging waste wood, charging the chips into a pressure vessel where they are subjected to 1,000-lb. steam pressure, and releasing the pressure suddenly, so that the chips are exploded into fiber. After refining, the fiber is formed into boards on a fourdrinier and pressed hydraulically. The original plant had a capacity of 100,000 sq.ft. of lumber and board per day. Within the past 18 months this capacity has been quadrupled. The daily consumption of waste wood is between 600 and 700 tons, part of which is burned as fuel.



The new boiler house of the Masonite Corporation is shown under construction at the left. It appears completed at the extreme left of the uppermost view.



The rod mills at the right are used in refining the fiber after it is exploded from the steam guns. The fiber is then formed into boards, after which the boards are trimmed on the machine shown above.

Chemical Engineering Education In North Carolina

AN EDITORIAL COLLEAGUE, in writing of the "South No One Knows," has called attention to the fact that behind the thriving industrialism of the New South lies an equally remarkable cultural development. In North Carolina, for example, the total annual expenditures for public schools increased from a million dollars in 1900 to more than thirty-six millions in 1927. Nor has higher education been neglected. The University of North Carolina, chartered in 1789, is the oldest state university in the country. Duke University is destined, it is said, to be the largest and richest in the world. And there are five other state-owned educational institutions, and thirty-two privately endowed schools and colleges in North Carolina.

In such an educational program it is logical that chemical engineering should have an important place. Since 1925 two of the state-endowed institutions have developed curricula and are training an increasing number of chemical engineers for Carolina industries. Their courses and the philosophy underlying them are discussed in the brief articles that follow.—THE EDITOR.

University of North Carolina Offers Unusual Facilities

By Frank C. Vilbrandt

Professor of Industrial Chemistry and Chemical Engineering, University of North Carolina, Chapel Hill, N. C.

CHEMICAL ENGINEERS belong to that class of engineers who find their primary interest in the design and operation of plants in which materials undergo chemical as well as physical change. The activities of the chemical engineer cover such a broad field that there must be specialization. Some chemical engineers become expert in design of equipment, some in construction, others in operation of particular manufacturing equipment and processes, while still others specialize in the development of processes from the laboratory to the manufacturing scale. For this specialized chemical engineering, fundamental academic training is necessary and it is pertinent to the state institutions to supply the men who will eventually direct the major portion of the chemical engineering activities in the state.

To cater to this demand the educational institutions of particular regions, especially where development of industrial resources is occurring, must provide proper facilities to train their sons to fulfill this demand for technically trained chemical engineers. The development of the industrial resources of North Carolina during the last few years, with the attending establishment of chemical industries within the state, has not found its state institutions lacking in preparing themselves to provide properly trained men to direct and further develop the chemical resources of the state. To this end a chemical engineering curriculum was established at the University of North Carolina in September, 1925.

University of North Carolina Has an Ideal Laboratory Building in Venable Hall

STANDARDIZED training in chemistry, supplemented by perfunctory visits to a few chemical plants and the carrying out of experiments with ordinary chemical laboratory equipment, does not give the proper point of view and training for chemical engineers. The application of laboratory results to plant scale processes is not as simple as it may seem. It is a far cry from handling a beaker full of hot chemical solution to transferring thousands of gallons of hot corrosive liquids from a jacketed kettle. The application of various mechanical and laboratory operations of chemistry to industrial practice, the unit processes of chemical engineering, has an entirely different meaning to the chemical engineer than to the research or control chemist.

The establishment of a properly designed course cannot always be accomplished, especially in a field as new as chemical engineering, where differences of opinion exist as to what courses constitute a proper curriculum. Local conditions often govern to a considerable extent the nature of the course of study. The expression of opinion of the committee on chemical engineering education of the American Institute of Chemical Engineers was used as a basis for the curriculum in chemical engineering adopted at the University of North Carolina, modification being permitted only where local conditions created an unavoidable obstacle.

In general the course adopted attempted to effect the following objects: (1) To supply the substratum of fact that may serve as a basis, and tools that may serve as a means, for developing analytical reasoning and expression. (2) To develop the proper attitude of mind toward the profession. (3) To supply inspiration and guidance in translation of chemical thought into action and accomplishment. (4) To supply training in the use of all tools that will assist in translating thought and work into permanent records. (5) To develop the proper

perspective of the chemical industries along economic and humanitarian lines.

The first two years of the curriculum in chemical engineering at the University of North Carolina are devoted to elementary chemistry, physics, drafting, mathematics through calculus, elementary mechanics, English, public speaking, report writing, general economics, advanced mechanics, inspection trips, and an introduction to chemical engineering.

The introductory course in chemical engineering entails a discussion of the field of chemical engineering, a study from catalogs, journals and trade literature of the different types of equipment involved in chemical engineering, a study of all the materials of construction used in chemical engineering practice, a study of the technical organization in chemical industries, and inspection trips to chemical industries in the state, upon which reports are required. In connection with this, one period a week is devoted to laboratory work on equipment problems. During this period, the sophomore engineers serve as laborers and assistants to senior chemical engineering students.

The summer after the sophomore year is devoted to general organic chemistry and to technical analytical chemistry; in the latter course the student learns the theory and laboratory practice in boiler and sanitary water, petroleum products, coal, iron and steel analyses, and assay of ores.

In the junior year the chemical engineering curriculum includes a special course in English (covering reading of selected classics and also technical report writing). There are courses in steam machinery, electrical measurements, physical chemistry, machine design, principles of chemical engineering, such as the theories involved in unit chemical engineering operations, and a course in fuels metallurgy and metallography. The latter course deals with fuels in general, with distribution, storage, utilization of and contracting for coals, flue gas analysis, fuel gas analysis and evaluation, pyrometry, ferrous and non-ferrous metallurgy, and the principles of metallography with laboratory work in photomicrography and the heat treatment of steel.

One summer, preferably following the junior year, must be devoted to shop practice in any one of the numerous near-by plants. A special form of report is required upon completion of this work to obtain credit.

In the senior year, specialization in chemical engineering is increased but a thorough course in business administration extending through the year is given the students by the School of Commerce. A course in crystallography and mineralogy is included. Chemical technology, the economics of chemical engineering industries, the study of individual processes, seminar work in gas manufacture, dyes, rayon, cellulose, electrochemistry, corrosion, petroleum, and coal byproducts utilization are taken up. Industrial stoichiometry, laboratory assignments in factory development problems with special emphasis on report writing, equipment and process foremanship problems, equipment efficiency problems on centrifuging, liquid transportation, levigation, ventilation, fume elimination, evaporation, heat flow, filtration, grinding and mixing are all included in the program. Laboratory conferences are conducted by the students on current laboratory problems. Each week an appointed student directs the conference. In addition, each student is assigned to a chemical engineering research problem in which use of the literature, preparation of a bibliography, organization of research work, acquisition of laboratory data, analysis of results, and derivation of conclusions are emphasized.

A WEEKLY program of industrial moving pictures is presented by the department of chemistry to augment the lectures in chemical technology. About 140 reels are shown each year. Occasional visits from chemists and industrial personnel directors are utilized to put the senior students in touch with industries and their needs through short talks. Attendance and a written report are required at all available industrial expositions.

The chemical engineering laboratories, located in the southwest section of Venable Hall (a sawtooth, factory type building), consists of a large chemical equipment and process room with floor space 32 ft. wide by 48 ft. long, and five small adjoining testing laboratories. The main equipment and process laboratory has a free headroom of 35 ft. to enable the set-up of factory-size equipment, and is provided with a traveling crane to facilitate movement of equipment and materials. A 3-ft. permanent balcony on one side, and a ledge around the other walls of the room, provide support for temporary and future steel lattice flooring for high level equipment, and additional elevated laboratory floor space. The laboratory is amply lighted and ventilated by two 48-ft. inclined bays.

View of One End of Chemical Engineering Equipment Laboratory in Venable Hall

Among process equipment with which the chemical engineering laboratory is supplied are the following: a 12-in. continuous filter, a vacuum shelf dryer, a surface condenser, a dry vacuum pump, a power-driven jaw crusher, a twin pebble mill, an 18-in. extractor, a 10-in. plate and frame press, one 40-gallon aluminum jacketed kettle, one 20-gallon aluminum jacketed kettle, one 15-gallon jacketed kettle with a set of mixing devices, permitting over twenty variations in styles and combinations of mixing equipment, a Duriron kettle, an experimental oil separator, one 10-gallon horizontal steam still, two arc furnaces, a paint mill, an experimental gasoline motor, a small methyl-chloride refrigeration plant, an air compressor, and a gas-fired furnace for large batch-high-temperature studies. Steam, water, gas and compressed air are supplied to all parts of the laboratory. Outlets for both alternating and direct current are distributed about the laboratory to supply power for the equipment which is essentially unit drive.

The five adjoining testing laboratories are completely equipped with apparatus and chemicals for the testing of sanitary and boiler water, coal, gas, petroleum oils, iron and steel, assay and sampling of ores, metallographic equipment for photomicrographic studies and furnaces for high-temperature work. As a small part of this equipment there are included: furnaces, calorimeters, gas analysis apparatus, small grinding equipment, a polishing machine, cameras, microscopes, and other standard apparatus.

Hoods, steam baths, desk space and lighting are all specially designed for the work. Gas, air, steam and water are provided in each laboratory. Equipment for specific tests is placed in special compartments with all solutions and apparatus, enabling each student to work on an individual determination in a separate compartment with all the necessary equipment before him. Each student is assigned to a private research room in the two-floor section of the building. Here he does his work on his research problem. In addition the university power plant and the university laundry are used as laboratories in fuel economy studies, giving the student an insight into the practical application of the theoretical work he has done in combustion.

Training Chemical Engineers At N. C. State College

By E. E. Randolph

Professor of Chemical Engineering
North Carolina State College of Agriculture and Engineering, Raleigh, N. C.

BASIC principles involved in the constitution of matter and its changes are the subject matter of chemistry. Energy manifestations accompanying these changes lie within the realm of physics. But the application of the principles and processes of chemistry, physics and mathematics in the design, construction and operation of equipment for the production of chemical materials is chemical engineering.

To me the engineering idea suggests production on a comparatively large scale in which considerable money is involved and in which the interests of many people are concerned. In addition to comprehensive technical knowledge of a highly specialized sort, the chemical engineer must have leadership in managing men. Such a conception of chemical engineering makes it apparent that special and rigid training is very necessary.

This was recognized ten years ago by North Carolina State College, at which time plans were started in order to lay a groundwork for a chemical engineering curriculum at this institution. A thorough study was made of chemical engineering education in the leading technical colleges of the United States and the outline of courses was such as to lead directly to the establishment of a strictly chemical engineering department. This action was officially taken by the board of trustees in February, 1925, at which time chemical engineering became one of the major departments in the Engineering School.

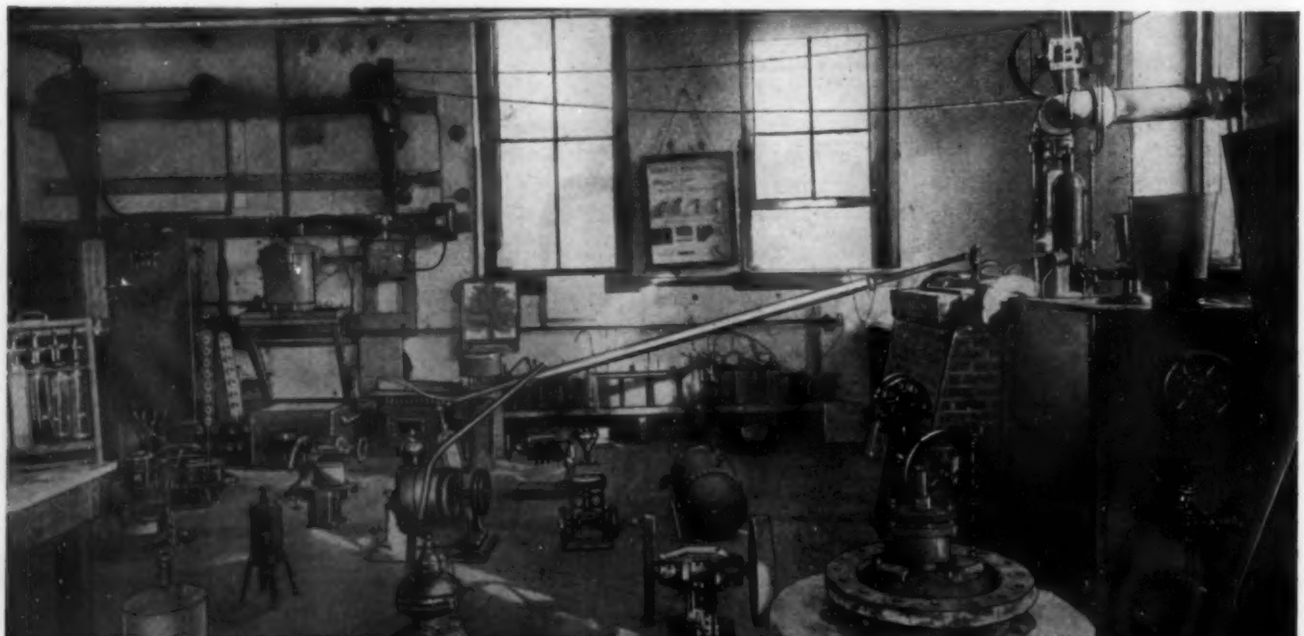
Two men were prepared to graduate the first year the curriculum was put into effect. In 1925 there were 22 students enrolled in the department. The enrollment doubled in the following year and has steadily grown, amounting to 63 in 1927, 90 in 1928, and 125 in the current year. There have been 30 Bachelor of Science degrees awarded during the period. This year there are 23 candidates for degrees in chemical engineering.

The curriculum in chemical engineering at North Carolina State College includes all of the fundamental engineering courses and a liberal proportion of humanistic subjects combined with specific training in chemical engineering. The graduates of the department are engineers. They receive state licenses as chemical engineers without examination after two years of professional work in chemical industries. This license, granted by the North Carolina State Board of Registration for Engineers, entitles the registrant to practice chemical engineering in every state that has a board of registration for engineers.

With the great recent growth in Carolina chemical industries, there has been an insistent demand for graduates of the department. In fact, in recent years, all have been employed before graduating. Most of the men receive employment in the large chemical industries of the South. In turn, these industries have co-operated whole-heartedly in the professional training of the students. Several thousand dollars worth of machinery and equipment—some of which is shown in the accompanying photograph—has been donated by leading manufacturers. Two valuable fellowships have been established by large chemical industries. Summer employment is provided by several firms and in many cases this temporary service has led to permanent employment after graduation.

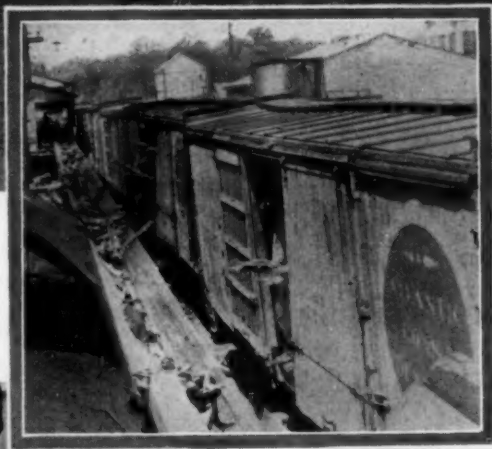
In training chemical engineers at North Carolina State College we recognize three factors of prime importance: Personality, character, and technical training. Lacking any of these a man cannot rise to a position of importance. Splendid training without personal and professional integrity is futile. And in the last analysis the chemical engineer's work is concerned not only with the materials and forces but also with men in the industry and in the community which the industry serves. Therefore, personality is of vital significance and we try to encourage and develop it so that our graduates may succeed in their profession.

A Corner in the Chemical Engineering Laboratory of North Carolina State College at Raleigh



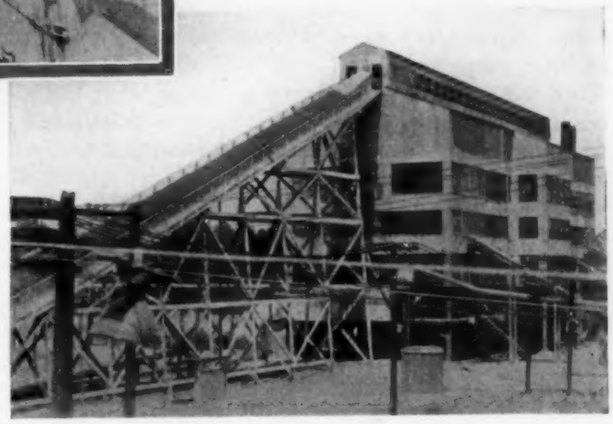
Above—Reserve supply of pine stumps at one of the Hercules Powder Company's plants. Plant in the background

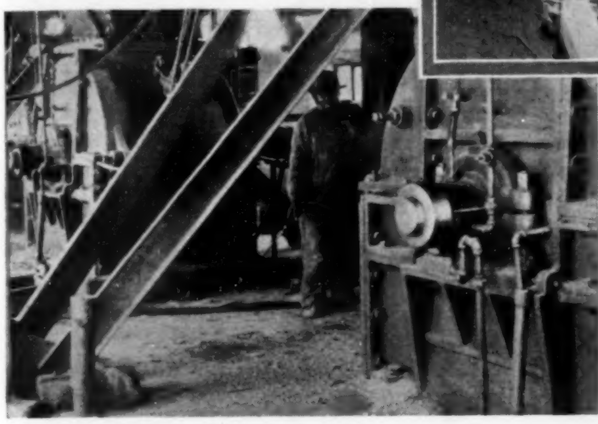
Below—Mill Room where the pine wood is reduced to shreds about the size of matches, ready for extraction



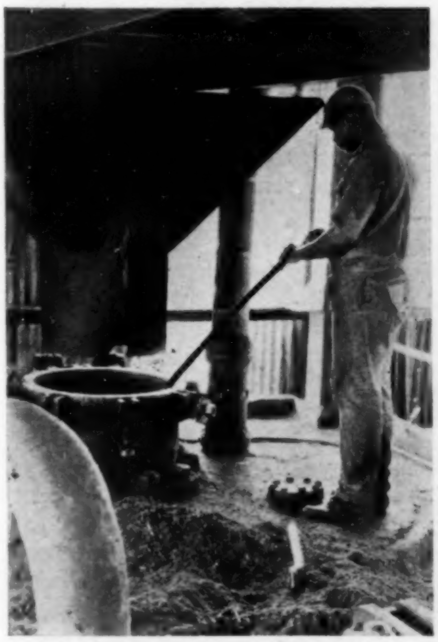
Left—Wood is brought into the plant in box-cars and unloaded directly to a conveyor

Below—Exterior view of an extractor house where turpentine, pine oil and rosin are recovered from the chips





Naval Stores—a Typically Southern Chemical Enterprise



Random views in the Brunswick, Ga., and Hattiesburg, Miss., plants of the Hercules Powder Company where turpentine, wood rosin and pine oil are recovered from pine stumps by the steam and solvent method

Left—In large vertical extractors such as the one at the left the chips are treated first with steam to remove the turpentine and part of the pine oil. Then countercurrent extraction with naphtha is used to separate the remaining pine oil and the rosin from the wood

Right—After purification by distillation the turpentine is weighed into containers for shipment

READERS' VIEWS AND COMMENTS

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest

Coke as Direct Source of Electricity

To the Editor of Chem. & Met.:

Sir:—The problem of generating power directly from coke has made very little progress during the last twenty or thirty years. However, on account of its great importance, perhaps it may not be amiss to restate the problem and to show how it would have to be solved if it is ever done.

Modern civilization depends fundamentally on the energy of the combination of carbon and oxygen to form carbon dioxide according to the reaction: $C + O_2 = CO_2$. If it were not for the energy of this reaction, steamboats, trains, and most of the factories would be at a standstill, and the only electric power available would come from waterfalls, which can supply only a small part of that consumed. As coal can never be replaced, it is of the greatest importance to use it with the highest possible efficiency. If a carbon-oxygen voltaic cell could be found, that would work at room temperature without appreciable polarization or internal resistance, theory shows it would convert 90 per cent of the heat of combustion into work.

Among the consequences of this solution would be the elimination of all smoke and soot. In place of furnaces, there would be a battery of carbon cells, and the electricity generated would be completely converted into heat in resistance coils, just where it is needed; at present a large part of the heat of furnaces goes up the chimney. In place of turning electricity into heat, it might be used to work refrigerating machines which would transfer heat from outdoors to the interior of houses, supplying sixteen times as much heat for a given amount of power (see "Thermodynamics," Lewis and Randall). In this case a house requiring 16 tons of coke a year for the furnace would need only one or less, and the principal part of the cost of heating would be the interest on the investment and its depreciation. The fuel bill of all industries would be reduced one-quarter or one-fifth of the present amount, and this would benefit everyone for a corresponding reduction in prices, both on account of lower cost of manufacture and of transportation.

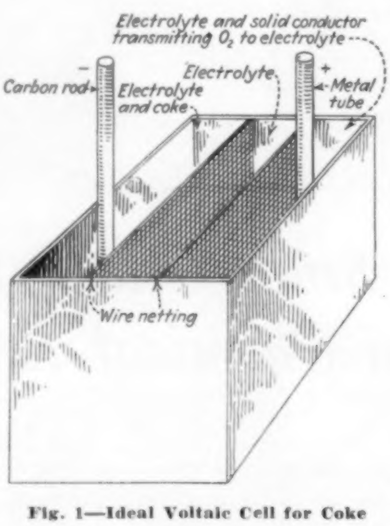


Fig. 1—Ideal Voltaic Cell for Coke

An ideal carbon-oxygen cell would be constructed according to the following conventional diagram:

Carbon in the electrolyte; negative pole.	Some unknown electrolyte, containing in solution carbon dioxide, partly dissociated into the ions.	Oxygen, dissolved in some solid, in the electrolyte; positive pole.
	C^{++++} and O^{--}	

The actual appearance of the cell might be as shown in Fig. 1. It would consist of a box of non-conducting material separated into three compartments by heavy wire netting to hold the coke in place at one end and the other electrode material at the other, both immersed in the electrolyte, which also fills the central compartment. Coke would be shoveled into the left compartment from which the ashes would be removed as they accumulate, and air would be blown into the right compartment over some electrically conducting material that would absorb the oxygen and transmit it to the electrolyte. Platinum does this to a certain extent, but would be too expensive for large-scale work.

The action of this cell would then be the solution of carbon and oxygen each into ions, the sum of the reactions being:

$$C + O_2 = C^{++++} + 2\,O^{--}$$

Since the solution is already saturated with both these kinds of ions, any excess formed by the action of the cell must disappear by their union to form CO_2 which would bubble off into the air. The requirement that the active substances unite by means of an intervening electrolyte would therefore be satisfied. The open circuit emf. of this cell would be approximately one volt at room temperature. There is another requirement which would have to be fulfilled in order to make this cell of any practical value: the reaction must be capable of proceeding at a high rate, comparable, for example, to that at which a lead storage cell will deliver energy. Otherwise it would take too many cells to accomplish anything. Also, some form of carbon that is a fairly good conductor of electricity would have to be used, such as coke or gas carbon.

The reason this cell has never been realized is that carbon does not dissolve in any known electrolyte, and all gas electrodes, including oxygen, are too easily polarized. However, it is not an impossibility that some electrolyte may exist in which these reactions would take place, although this is unlikely.

A possible solution of this problem is outlined below. Some substances in aqueous solution, such as cerium salts, are easily oxidized by air and are reduced by carbon. Therefore the ratios of the concentration if oxidized to reduced salt would be different at the two electrodes, and there would consequently be a tendency to produce an electric current. At the cathode the salt in the lower state of oxidation would be formed in producing current, and would be regenerated by oxygen; at the anode the salt in the higher state would be formed, and would be reduced by carbon. Cells which operate in this way are known, but the reaction velocity is too low to produce electricity in any appreciable quantity. Furthermore, the electromotive force would not necessarily be that calculated above, but would depend on the properties of the salt used. M. DEKAY THOMPSON.

Massachusetts Institute of Technology,
Cambridge, Mass.

New Mineral Resources Discovered in Louisiana

To the Editor of Chem. & Met.:

Sir:—A most interesting mineral situation is developing near Winnfield, La., in which I think the readers of your magazine might be interested.

The surface deposits are the only limestone between the Gulf of Mexico and the mountainous section of Arkansas, and the chalk deposits of central Texas and the limestone deposits south of Birmingham. For many years this limestone has been quarried for local crushed rock purposes. In the past few months it has been found that the limestone is underlaid with a very heavy deposit of pure gypsum, and the gypsum underlaid with a hundred feet of iron pyrites. Some test holes show the pyrites to run as high as 47.87 per cent sulphur. Under the pyrites is a dome of pure rock salt. Another interesting feature is that in opening up a new quarry face a considerable amount of pure barium sulphate in a pulverized form was found in the overburden. Indications are favorable that the deposit of barium will be of commercial size. A considerable amount of iron ore is found in the hills closely adjacent to the limestone deposits and also veins of iron ore of over 50 per cent metallic iron are being found in the lower portions of the limestone.

One of the most interesting phases of these deposits is that all of the minerals which I have mentioned are found on less than 200 acres.

WILLIAM CROOKS.
Little Rock, Arkansas

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Aluminum Chloride: Its Price and Purity

To the Editor of Chem. & Met.:

Sir:—In your July number is an important contribution by Dr. A. M. McAfee, giving a history of his efforts, supported by Gulf Refining Company, to produce, in large quantities and at a reasonable price, a commercial grade of aluminum chloride for use in the refining of petroleum. Dr. McAfee is to be congratulated on the success that has crowned the persistent labor of many years; the company that provided the sinews of war in such ungrudging fashion is entitled to the rewards that it will reap as the result of its far-sighted policy in financing the ambitious research program.

However, to obtain a true perspective of the situation we must bear in mind that the production of aluminum chloride on a commercial scale at a moderate price is not entirely new, even if it did not suffice for the enormous demands of the oil industry. The figure of $1.50 per pound, mentioned by Dr. McAfee as prevailing in 1913, has long ago passed into history. For about eight years this material, produced, e.g., by Savell-Sayre & Company, of Niagara Falls, N. Y., has been freely offered at prices that have ranged from 25c. down to 10 or 12c. Moreover, this product, instead of testing only 94 or 95 per cent as obtained by the McAfee process, is 99 per cent plus, practically C.P. It is granular, not a powder, a significant factor in an anhydrous substance. Neither must we forget the items of packaging and delivery point. Drums will cost from 0.5c. to 1c., depending on size, and are not always returnable; freight rates are high.

The difference in the grade is accounted for by the raw material used. Bauxite, as Dr. McAfee points out, contains considerable quantities of iron and silica. The Niagara Falls process consists of bringing together chlorine gas and pure aluminum in an electric furnace; the resultant aluminum chloride is collected in a condenser, and immediately packed in airtight, sealed drums. The combination of pure chlorine and pure aluminum, with minimum exposure to the air, yields the grade described above.

Dr. McAfee was, of course, working with his thoughts on oil refining, where the highest degree of purity is not essential. Requirements of the dye industry and of the chemical laboratory are more rigorous. This situation is taken account of by McAfee's use of the term "commercial." The distinction, however, might not always be present in the mind of the buyer who is reading market reports. It would seem reasonable therefore that in printing prices on this article one should differentiate between "commercial" and "pure," and should also take into account (as McAfee has done in limiting his 5c. price to car lots) the size of the package, the question as to whether drums are free or extra, and the point where delivery is made. It would also be helpful to state whether the quotation is for granular or powdered.

M. H. HAERTEL.
10 Orange Ave.,
Cranford, N. J.

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A Fertile Field for the Farm Board

To the Editor of Chem. & Met.:

Sir:—Your timely editorial "Why Not an Investment in Co-operative Research?", appearing in the October issue, should be sent to some of our local farm organization people; the apple, wheat and poultry organizations can profit by the suggestions made, I believe.

Several years ago when the subscriber was working on an engagement for one of the trade association groups selling to the agricultural people he had an interesting instance of the thought given in the second paragraph of the editorial. An alfalfa and stock rancher spent some time in showing where the policy of the local state college and agricultural agent and also our association policy was wrong—a policy looking to bringing more land under cultivation and producing greater yields per acre and per dollar expenditure. This rancher said what they most wanted was some one to help them find new markets and new uses for their crops and suggest new crops that would find use; that greater yields and lower costs were all right but meant little while there was no market for the product.

If the Farm Board will spend some money along the line suggested in the editorial, good results are certain to come.

CHARLES A. NEWHALL.
Chemical Engineer,
Seattle, Wash.

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DIRECT HEATING of liquids for purposes of evaporation or concentration is reported by C. H. S. Tupholme in *Industrial Gas* for October. A combustion unit, within the liquid, discharges its gases as minute bubbles through the liquid, giving an aeration and stirring effect which prevents overheating and incrustation of salt. An advantage is rapid heating; and where gas contact is undesirable an indirect application of the principle is still economical, according to the report.

Chemical Engineer's Bookshelf

Starch as a Chemical Product

STARCH, ITS CHEMISTRY, TECHNOLOGY AND USES. By *Lewis Eynon* and *J. Henry Lane*. W. Heffer & Sons, Ltd., Cambridge, England. 244 pages. Price, 12s. 6d.

Reviewed by CARL S. MINER

AN AUTHOR who attempts to cover the subject, "Starch, Its Chemistry, Technology and Uses," within a compass of 250 pages should be judged on the basis of what he has done rather than what he has failed to do, since he has so obviously, yet so courageously, undertaken the impossible.

On this basis, there is much to commend. The chapter on the "Constitution of Starch" sums up our present lamentably inadequate knowledge extremely well and provides, in addition, a reasonably complete historical background, although one feels that the space given to certain of the earlier theories might better have been devoted to the phases of the subject which we now believe to have greater claims to validity.

A book of this sort brings home to us in convincing fashion the fact that while science is international, technology is very narrowly national, for while the chapters such as "Construction of Starch," "Properties of Starch" and "Microscopy of Starch" are of equal value in this country and in England (where the book was published), the chapters which treat of the manufacture and uses of starch and starch products are of very little value to an American chemist interested in obtaining up-to-date information in regard to the starch industry of his own country. The manufacture of potato starch is described in a chapter of over forty pages, whereas the corn-starch industry, which is practically the only starch industry of substantial importance in this country, is briefly and very inadequately treated in a chapter of ten pages.

The authors state that much of the information in regard to potato starch manufacture is derived from a book published in 1897, and certainly the information given in regard to corn-starch manufacture is not accurately descriptive of modern practice in that industry. A fair judgment in regard to the value of this book to the American chemist would give it an excellent rating on those chapters devoted to the pure science aspects of the subject, but would rate it as of no practical value to the searcher after information in regard to the American starch industry.

* * * *

The Synthetic Resin Situation

DIE KÜNSTLICHEN HARZE. By *Johannes Scheiber* and *Kurt Sändig*. Wissenschaftliche Verlagsgesellschaft m.b.H., Stuttgart, 1929. 376 pages. Price, 28 M.

Reviewed by CARLETON ELLIS

WRITING a comprehensive treatise on the subject of synthetic resins is fraught with many difficulties. Activity in the synthetic resin field has increased in recent years to a degree disproportionate to the magnitude of the industrial applications involved. It is a simple matter for anyone to prepare some sort of a synthetic resin and each modification in proportion, temperature and other conditions suffices, in most instances, to yield a product differing slightly or considerably from its neighbor. The number of synthetic resins, therefore, is legion and this very multiplicity and the difficulty of classification confronts the writer with many trying obstacles. In the first place there is the question of what constitutes a synthetic resin. The authors of this book have devoted an introductory section of about 40 pages to a definition and description of the typical properties, then submit the definitions propounded by Haber and by von Weimarn and comment as follows: "Diese Definitionen sollen natürlich in keiner Weise Anspruch erheben, endgültige zu sein."

Following the introductory portion is an interesting section on the two principal classes of resinifying reactions; namely, polymerization and condensation, each of which covers about 60 pages. This classification permits of convenient description of a very large number of resins of different characteristics. Some of the resins which are very briefly described but which have had, or are experiencing, important industrial applications, probably should have received more adequate treatment and their commercial possibilities pointed out. One such group, for example, is that derived by reaction between polybasic acids and polyhydric alcohols, such as the phthalic anhydride reaction products with glycerol and glycol, diethylene glycol and related bodies. The physical properties of some of the resins in this group are such as to promise very wide industrial applications, nevertheless the subject is treated by Scheiber and Sändig very briefly. In the description of sulphur-containing resins, particularly those made by reaction of sulphur chloride on phenols, their complete miscibility with sulphur, a significant property rarely found in the synthetic resin field, lacks adequate mention.

The theoretical discussion and the description of various special resins occupies about one-half the book, the balance of the volume being devoted to a discussion of the technically most important groups. This section opens with a rather full treatment of cumaron resin, the space devoted to it being slightly out of proportion to its importance as compared with phenol formaldehyde resin. In the cumaron resin section mention does not appear to be made of the growing use of cumaron resin in chewing gum compositions as a chicle substitute. The phenol formaldehyde section on the other hand, covers the ground with adequate and compact treatment from the historical and development standpoint.

Missing from the volume, however, is a description of molding (hot pressing) phenol formaldehyde molding compositions on commercial scale. The development of synthetic resins has been greatly stimulated by the demands of the plastic molding industry for a resin which has the property of melting when first forced into a hot mold and then quickly setting to a hard, infusible, shaped product of great strength. Hard rubber compositions are readily produced by hot-pressing but not at a speed comparable with the demands of the molding industry. Unquestionably Dr. Baekeland was responsible, through the development of Bakelite, for establishing in the industry a thermo-setting molding composition which could be charged into a hot mold and in the course of one or two minutes be removed as a shaped and infusible article. The industry of hot-pressing these high-speed setting compositions has grown by leaps and bounds, not only in this country but elsewhere. The reviewer, therefore,

feels that a book on the subject of synthetic resins which purports to include their industrial applications should devote considerable space to the art of hot-pressing, and to those requirements in a thermo-setting composition of the synthetic resin type which a molder insistently demands. With each new synthetic resin the problem arises of its evaluation from an industrial standpoint. In the first place, is it cheap enough to be used in this or that manner, has it the proper physical qualities of strength, color, and so forth, to pass muster, and above all, if its promise resides in the molding field, what are its thermo-setting characteristics? Detailed information helpful in such an appraisal does not appear in the book.

Again, the rapidly expanding use of modified (that is, oil-soluble) phenol formaldehyde resins in the varnish industry seems to lack adequate depiction. The race via synthetic resins between the varnish maker and the manufacturer of lacquers could be made the basis of a very vivid picture. When, some years ago, the nitrocellulose lacquers showed promise of becoming competitive with oil varnishes, the varnish manufacturer sought to increase the speed of drying of varnish and ultimately turned to synthetic resins of the phenol formaldehyde type. Using these in oil-soluble form he was able to shorten the drying time, leading to the wide-spread production of what is known as a "four-hour varnish." Nitrocellulose lacquers, unless pigmented to protect them from actinic rays, fail rapidly on outside exposure and cannot in this form compete with, for example, spar varnish. These conditions led to the development of synthetic resins of a character adapted to protect nitrocellulose, typified by the group of polyhydric alcohol resins such as those known as "Rezyls." The meagreness of data by Scheiber and Sändig on these and other types filling an important niche in the coating industry is regrettable.

The publication does not attempt to treat of modified natural resins or "semi-synthetic" resins as they sometimes are called. Hence the scope precludes a discussion of esterified rosin or ester gum, and of such promising coating and plastic agents as the chlorinated rubbers.

The volume is replete with references to various publications and patents and appears to be quite complete in this respect. It represents a source of information decidedly helpful to any worker in the field of synthetic resins and should serve as an additional stimulus in the future progress of the plastic industry.

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Germany's Chemical Organization

PROBLEME DER DEUTSCHEN CHEMISCHEN INDUSTRIE. By *Peter Waller*. H. Meyer's Buchdruckerei, Halberstadt, Germany. 241 pages. Price, 17.50M.

Reviewed by THEODORE M. SWITZ

DURING the first quarter of the twentieth century the chemical industry has emerged as a great, basic, key industry of vital importance in the economic structure of modern nations. Dr. Waller achieves a pioneer task in studying this transition from a small-scale industry of scattered independent producers to the vast, complex, highly integrated companies and cartels of today.

The book covers two major problems: the organizational structure of the German chemical industry, and its economic problems. The origin of the I.G., which was not formed until November, 1925, is traced back to the famous memorandum written by Dr. Duisberg to the leading German dye firms in 1904. This memorandum proposed consolidation, pointed out advantages, and laid plans with such foresight that it subsequently became almost the foundation on which the I.G. was built. In the section on economic problems, the author discusses the dyestuffs industry, the fixed nitrogen and fertilizer industries, the heavy chemical industry, the coal liquefaction industry and others from the international viewpoint as well as in relation to the German domestic market.

This book has a certain aspect of superficiality because an attempt is made to touch upon every problem of a complex industry, with the result that it frequently merely catalogs rather than analyzes. However, there is much of interest for the American reader who seeks special knowledge of the German chemical industry, since it offers many comparisons with our own. Dr. Waller's work is a worth-while contribution to the embryonic literature on chemical economics.

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Pageants of Chemistry for Everybody

POPULAR RESEARCH NARRATIVES, Vol. 3: Tales of Discovery, Invention and Research. Collected by the Engineering Foundation. The Williams & Wilkins Company, Baltimore, 1929. 174 pages. Price, $1.

LIKE its predecessors, this volume contains 50 short stories of research, invention and discovery prepared by "the men who did it." The stories cover a wide variety of scientific subjects and are written in a non-technical style for the non-technical man. The Engineering Foundation is to be praised for sponsoring this movement to better inform the layman in scientific developments.

DAS BUCH DER GROSSEN CHEMIKER. Edited by *Günther Bugge*. Vol. I. Verlag Chemie, G.m.b.H., Berlin, 1929. 496 pages. Price, 24M.

TO NARRATE the story of chemistry as a succession of great names, in the sense of Carlyle, is the commendable purpose of this undertaking. Of the two volumes planned to cover the ground, this first, ranging from Zosimos (+420) to Schönbein (+1868), indicates that even this rather eclectic method may remain inclusive and show an uninterrupted flow.

The book can appeal, naturally, only to those with both an interest in their technical antecedents and a sustaining knowledge of German. But under these assumptions the book represents a true offering. The fourteen contributing scientists, including such names as Ostwald, Walden and Bloch, were apparently chosen as much for their simple grace of style as for their knowledge, while the publisher has enriched the volume not only by its splendid appearance and workmanship but additionally by the insertion of a great number of illustrative plates.

LA GRANDE OEUVRE DE LA CHIMIE. Chimie et Industrie, Paris, France. 250 pages. Price, 35 Fr.

FRANCE'S new contribution to the popular and educational writings on chemistry has successfully resorted to all devices for inviting the general reader and student to its pages while subduing the terror that the subject is likely to strike to his incurious mind. Its format is handsome and large, the printing is library rather than text-book style, and a swarm of drawings detains the eye from the text.

Naturally, the fervor of this class of books is not absent; thus we are urged to believe, as usual, that chemis-

try "is intimately linked to man's entire existence," that, in fact, "elle donne à la vie matérielle sa splendeur et son charme." But the main body of the preachment is more reasonable and becomes progressively more so as the separate sections move from metaphysical to concrete industrial considerations, where scientific specialists wield the pen. Thereafter every conceivable application of chemical industry (even such exotic activities as cider mills and distilleries) is subjected to a succinct but authoritative treatment of its general and technical aspects, all within the bounds of good sense. In view of the sober and pithy manner of these scientists, who really form the substance of the book, the chances of its wider dissemination seem assured.

* * * *

Welding as an Engineer's Tool

Arc Welding: Lincoln Prize Papers. Submitted to American Society of Mechanical Engineers. McGraw-Hill Book Company, New York, 1929. 421 pages. Price, $5.

IN 1928 the Lincoln Electric Company, acting through the American Society of Mechanical Engineers, offered prizes totalling $17,500 for the three best papers on arc welding. Of the 77 papers submitted, seven of outstanding value have been published here.

With the need of the chemical engineer in mind, the first thought of the reviewer is that the volume bears somewhat heavily on ship construction, as three of the seven papers go into the subject very thoroughly. On the other hand, at least one of the three, the first prize winner, also gives an almost staggering amount of data of a general engineering nature, much of which is directly applicable to chemical engineering needs.

Another paper gives valuable information on the arc welding of pipe lines, while there are none that do not advance our knowledge of the general uses of arc welding to a greater or lesser degree. All in all, the book may be said to advance a clear, convincing and unbiased report of modern electric arc welded construction.

The Oxy-Acetylene Welder's Handbook. By *M. S. Hendricks.* The Acetylene Journal Publishing Company, Chicago, 1929. 203 pages. Price, $3.

FEW ENGINEERS will ever handle a welding torch themselves, but yet will find this handbook of value. While it is written in a simple and non-technical manner for use by the practical welder, very little of the information in its 200 pages is of a type to be out of place in the library of the engineer who designs for or specifies welding. Such subjects as welding gases, types of welds, weld inspection and testing, training of operators and welding properties of the common metals, to mention only part of the range of the book, may well be considered necessary adjuncts to the engineer's bag of tricks.

* * * *

The Private Life of G. E.

Forty Years with General Electric. By *John T. Broderick.* Fort Orange Press, Albany, N. Y., 1920. 218 pages. Price, $2.50.

IT IS from his long and intimate association with his company, and not from any educational cause, that the author receives the impulse to his narrative. His lack of ulterior purpose, in fact, proclaims the group whom he expects to interest; not the student of corporate history as management, but the man with human curiosity or attachment for one single company, the General Electric. This name, however, is tolerably well-known, and so too are such names as Thomson, Coffin, Rice and Steinmetz; Mr. Broderick then need not fear a poverty of ears for his reminiscences. These are recounted in a not wholly orderly flow, but more than compensate for the unrigorous sequence by their personal color, derived from both his unusually long period of association and his real, unobtrusive talents.

* * * *

Newly Arrived

Smith's College Chemistry; Laboratory Outline to Smith's College Chemistry. Revised Edition. By *James Kendall.* The Century Company, New York, 1929. 795 and 198 pages. Price, $3.75 and $1.50, respectively.

IN THIS revised edition, Smith's Chemistry, with its successful background of education in general chemistry, has had almost every chapter expanded, with special emphasis on advancements in the past few years. These include atomic and molecular structure and weights, and ionization of electrolytes. The book's value as a reference work, as well as a text, is therefore assured now as in the past. The laboratory guide, issued separately, is designed to direct the attention to the basic chemical significance of the work in hand; its value is hence confined mainly to students.

Chemical Engineering Catalog, 1929. The Chemical Catalog Company, New York, 1929. 1205 pages. Price, free for return of last previous edition; $3 to various professional classes; $10 to all others.—An expansion throughout its various sections distinguishes this edition from its useful predecessors.

Chemist's Pocket Manual. Fourth edition. By *Richard K. Meade.* Chemical Publishing Company, Easton, Pa., 1929. 533 pages. Price, $3.50.—Revised in the light of new data accrued in the past ten years; though the emphasis is on chemical rather than engineering usefulness, yet a number of industrial fields also are covered.

The Mineral Industry, Its Statistics, Technology and Trade During 1928. Vol. XXXVII. Edited by *G. A. Roush.* McGraw-Hill Book Company, New York, 1928. 802 pages. Price, $12.—Once more this guide book to the mineral industry has made its appearance, this time as thirty-seventh of its kind. The effort is being made ever more successfully to enlist contributors with broad contacts in their fields; in the volume's new appearance, this fact is gratifyingly apparent, in addition to its customary features.

Six Place Tables. With explanatory notes by *Edward S. Allen.* Third Edition. McGraw-Hill Book Co., 1929. 167 pages. Price, $1.50.—This small pocket-sized volume, flexibly bound, is intended to assist in all engineering calculations which must be carried beyond the range of a slide rule; the tables, nearly all of which are carried to six places, include practically all those likely to be used in engineering calculations.

Bibliography of Bibliographies on Chemistry and Chemical Technology. First Supplement, 1924-1928. By Clarence J. West and D. D. Berolzheimer. Bulletin 71, National Research Council, Washington, 1929. 162 pages. Price, $1.50.—As the title indicates, this is a supplementary list of bibliographies that have appeared in books and articles, grouped according to subjects.

Sedimentary Kaolins of Georgia. By Richard W. Smith. Bulletin 44, Geological Survey of Georgia, Atlanta, 1929. 482 pages.—Very complete survey of Georgia kaolin comprising its history, geology, uses, and future; illustrated with photographs and firmly bound.

Selections from Recent Literature

LOW-TEMPERATURE CARBONIZATION. Domenico Meneghini. *Giornale di chimica industriale,* September, pp. 391-9. Operating results are reported for the "Sistema Italiana" (Piron-Scavia) low-temperature carbonization furnace. The principal difference between this furnace and the Piron furnace as developed in America is that the former does away with the molten lead bath which is a feature of the Piron furnace. The installation from which results are now reported was put into operation in Genoa late in 1927. Its first few months of operation were not entirely satisfactory. Some modifications were therefore made and satisfactory operation was attained. The thermal yield from lignite is reported to be 86.20 per cent of the heat value of the original lignite, 66.13 per cent being obtained as semi-coke, 10.38 as tar and 9.69 as gas. Experimental runs are described with gas coal and with lignite, and the thermal balance is stated for each. Certain structural modifications, which were necessary to meet local conditions at the Genoa gas plant, are also described. In judging the commercial possibilities in the development and application of this type of furnace, the quality and yield of primary tar should be duly considered.

COUNTERCURRENT LEACHING. Kurt Thormann. *Chemische Apparatur,* Sept. 10, pp. 184-6; Oct. 10, pp. 209-11. Mathematical equations are derived, expressing the principles which govern leaching on the countercurrent plan. Processes actually occurring in the leaching vessel depend largely on the amount of solvent, the time of contact and the effect of these variables on the composition of the solution; but for most economical operation other factors must also be considered, especially the time required for the different operations and its relation to the number of leaching vessels. The best procedure varies according to the material being treated; but in general two time factors can be distinguished for each leaching vessel, namely time of contact, and discharging time. An equation in terms of these variables is therefore given. Sample calculations are given, to show how the equations may be used to ascertain the optimum number of leaching vessels for a given case, or the most economical procedure in a given number of vessels. Sketches are also shown of the flow of liquor for leaching in 5, 6 or 7 passes through a battery of vessels.

GAS HAZARDS. Arthur Ringel. *Chemische Fabrik,* Sept. 18, pp. 415-7; Sept. 25, 429-30. Sewers, whether for city sewage or industrial effluents, may introduce hazards in chemical plant operation from accumulation of explosive gas mixtures. Volatile flammable liquids from the chemical plant itself, if run into the sewer, may vaporize and form explosive mixtures with air. For testing the atmosphere, the Pieler safety lamp (utilizing the Davy principle) is a useful safety device; but it is not reliable for detecting heavy gases and the user must himself enter the atmosphere to be tested. This drawback is largely responsible for the invention of the diffusion type of detectors, for which the gas is sampled with a rubber tube and bulb. Of the diffusion detectors, the Sewerin design is considered preferable to the Strache and Nellisen detectors. It can be used, for example, for tracing a dangerous contamination to its source. Another useful tester is the instant glow detector, an electric lamp device which will not give a spark and therefore will not ignite a flammable gas mixture. Specific applications of these instruments in chemical plants are discussed and photographs are shown.

LEAD COIL CORROSION. Karl Kieper. *Korrosion,* Sept. 25, pp. 41-2. A case is reported of corrosion of lead coils used in the manufacture of ammonium chloride from ammonium sulphate and sodium chloride. It was observed that hard (antimonial) lead corroded more easily than very pure lead. Another peculiarity was that the steam coils in evaporators concentrating the final ammonium chloride solution were quite durable, whereas the coils in the reaction tank were quickly attacked. Coke byproduct ammonium sulphate contains free acid, which when heated in the presence of salt would liberate hydrochloric acid; hence the crude sulphate should be neutralized before use. Antimony chlorides are much more soluble than lead chloride; hence the pipe lead should contain no antimony. The more rapid corrosion in the reaction tank, as compared with the evaporator, is due to liberation of chlorine compounds in a nascent state in the conversion of sulphate to chloride. It is accelerated by heat on account of the fact that the parts of the pipe with which the reacting solution comes most in contact are also the hottest parts. Various attempts to stop the corrosion, retaining the use of lead pipe, failed. Finally iron apparatus, with iron steam coils, was adopted, and it was found that a protective oxide layer formed which practically stopped the attack on the pipe. Alkaline additions to the reacting system were also observed to be helpful.

THERMOCHEMISTRY OF METALS. W. A. Roth. *Zeitschrift für angewandte Chemie,* Oct. 12, pp. 981-4. In view of the importance of thermochemical behavior of metals in their preparation from ores and in their use for making alloys, it is unfortunate that so little is known of the heats of formation and dissociation of oxides, sulphides, carbides and other compounds involved in metallurgical processes. A critical discussion, therefore, is given of the thermochemistry of iron, manganese and nickel. Calorimetric determinations were made of the heats of oxidation and reduction of various compounds of these metals. In most cases the observed heats of formation were higher than the commonly accepted values, the differences sometimes being quite large. A regular decrease with rising atomic number was observed in the heats of formation of the oxides, carbonates and carbides of manganese, iron and nickel. Tables of these heats of formation are given, at constant volume and at constant pressure, showing the probable limits of error. As an example of a metallurgically important reaction, published heats of formation of cementite range from 8.5 to —19.2 cal. On the basis of the new determinations, the true value is believed to be about —5.4 cal.

REFRACTORY MATERIALS. M. Pulfrich. *Korrosion und Metallschutz,* September, pp. 193-9. The influences which attack refractories in service in processing equipment can practically all be classified under the headings: heat (with or without pressure), mechanical erosion (chiefly by solids), and chemical corrosion (chiefly by liquids and gases). It was long considered sufficient characterization of a refractory to know its alumina content and its thermal resistance; but other factors have demanded recognition, including particle make-up and uniformity, shape of articles, method and temperature of manufacture, porosity and its changes in use, strength under load, and thermal properties (expansion and conductivity). For instance, a close-grained, dense stone will have more resistance to mechanical and chemical attack, but less to temperature fluctuations, than a stone of loose and porous structure. Aside from the properties of the refractory itself, skillful masonry and use of proper cements have much to do with performance life. Extreme cold does not harm a refractory wall or lining, or stored shapes, if dry; but frost breakage may be expected if the refractory is wet. If the first firing of a newly made refractory structure is done too quickly with too high a temperature, shrinkage will occur and arches will collapse. For some uses, refractories can be protected from erosion and corrosion by a coating—e.g., a ceramic glaze or graphite. In some cases external cooling is practicable. Applications of these and like considerations to practical operation of glass furnaces, cement kilns, blast furnaces, and the like are discussed.

RESPIRATORS. G. Stampe. *Zeitschrift für das gesamte Schiess- und Sprengstoffwesen,* September, pp. 360-3. Chemical (oxygen generating) respirators, as now made and used, have the economic drawback of not having their output adjustable to the demand. Thus, for only slightly unfavorable respiratory conditions the respirator, if adequate for severe use, gives a large excess of oxygen over the actual deficiency. The physiological nature

of respiration is discussed in some detail, to show how oxygen demand is regulated in accordance with expenditure of muscular energy and other factors, and to bring out the essential difficulties in the way of designing an oxygen supply respirator which can be made variable according to demand.

PULP DIGESTERS. Klein. *Zellstoff und Papier,* October, pp. 681-2. The new Morterud system of forced circulation has been successfully applied to sulphite digesters for pulp manufacture. It was first brought out before the War, but arranged with indirect heat from outside. It has now been improved by introducing the steam directly into the digester liquor. The original purpose of the preheater (indirect heat) was to avoid dilution of the liquor with steam; but in sulphite cookers the dilution problem is not serious and the advantages of direct heat are preferable. Although the Morterud invention is operating successfully, particularly in Scandinavian pulp mills, it has certain disadvantages which make it desirable to evolve a still better system. By placing the entire heating apparatus inside the digester it uses up useful space, and offers increased surface for deposit of calcium sulphate and dirt. Its steam and pump connections interrupt the continuity of the digester wall in its vertical portion. Some suggestions are therefore made for improvement in design, placing the heating apparatus outside the digester, and providing sufficient heat insulation to preserve the thermal efficiency. Having the pump accessible for repair would be an advantage, even though repairs are rarely needed, and the pulp would be kept cleaner than in the system more generally in use.

CREEP OF ELECTRIC FURNACE ALLOYS. A. Glynne Lobley. *Metal Industry* (London), Oct. 4, pp. 315-8. Increasing use of alloys of nickel and chromium for resistors and structural parts of electric furnaces made it desirable to ascertain the deformation behavior of these alloys under load at high temperatures. The 80:20 alloy was chosen for the tests, because of its common use for the purpose stated and because of its high resistance to oxidation. The tests were made by measurement of the creep of wires of the alloy at known temperatures, with a view also to ascertaining whether there was a creep stress limit. Above 900 deg. C. there was no evidence of a creep stress limit; slow but definite flow could be observed with the smallest test load (50 lb. per square inch). Between 700 and 900 deg. there was no creep stress limit with fine wires, but inconclusive evidence was observed of such a limit with thicker wires, apparently between 200 and 400 lb. per square inch. Although flow was observed with small stresses, the deformation was small. Limiting stresses which may be imposed in practical operation of electric furnaces, without appreciable distortion, are stated on the basis of the observed results. These results are summarized in curves and tables.

Recent Government Publications

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Gas Compressors. War Department Air Corps Technical Regulations 1170-86. 5 cents.

Standard Samples Issued or in Preparation. Supplement, dated July 1, 1929, to Bureau of Standards Circular 25. 5 cents.

Soaps, Washing Compounds, and Toilet Preparations Industry in Canada Continues Increased Production, by Jesse B. Jackson. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 290. Mimeographed.

Markets for Building Materials, Part I—Canada and Newfoundland. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 655. 10 cents.

Sheet Steel. Bureau of Standards Simplified Practice Recommendation R28-29, 2d edition. 10 cents.

Grinding Wheels. Bureau of Standards Simplified Practice Recommendation 45 (First Revision). 10 cents.

Lyons, France, and the Lyonnais Region—Center of Perfume Material Industry Derived from Essential Oils and Coal Tar Products, by Consul Hugh H. Watson, Lyon. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 287. Mimeographed.

Linseed Oil. Statistical and cost report of the U. S. Tariff Commission to the President. 15 cents.

Regulations Concerning Sodium Mining Leases and Prospecting Permits, Approved June 14, 1929. General Land Office Circular 1194.

Potash Core Tests. Press Statement, dated Oct. 18, issued by U. S. Geological Survey. Results of tests of eleventh and twelfth potash cores drilled in Texas. Mimeographed.

Manganese Ore Reserves at Philipsburg, Mont. U. S. Geological Survey press memorandum released October 16. Mimeographed.

Fuel-Efficiency Tests on Batch Oil Stills, by H. Kreisinger, W. R. Argyle, and W. E. Rice. Bureau of Mines Bulletin 302. 20 cents.

Factors Governing Removal of Soluble Copper from Leached Ores, by John D. Sullivan and Alvin J. Sweet. Bureau of Mines Technical Paper 453. 15 cents.

Temperature for Rapid Self-Heating of Powdered Coal and the Semi-Coke Made Therefrom, by F. A. Hartgen and David F. Smith. Bureau of Mines Serial 2960. Mimeographed.

Sources and Distribution of Major Petroleum Products, Atlantic Coast States, 1928, by E. B. Swanson. Bureau of Mines Information Circular 6187. Mimeographed.

Marketing of Gypsum Products, by R. M. Santmyers. Bureau of Mines Information Circular 6157. Mimeographed.

Gypsum: Its Uses and Preparation, by R. M. Santmyers. Bureau of Mines Information Circular 6163. Mimeographed.

Twentieth Semi-Annual Motor Gasoline Survey, by E. C. Lane, S. S. Taylor, and C. J. Wilhelm. Bureau of Mines Serial 2959. Mimeographed.

Arsenic, Bismuth, Selenium, and Tellurium in 1928, by V. C. Heikes. Bureau of Mines Mineral Resources separate. 5 cents.

Production of Natural Gasoline Increases, Though Rate of Increase Slackens. Preliminary mimeographed Mineral Resources statistics of the Bureau of Mines. Press release dated October 12, 1929.

Trade Practice Conferences. Summary of 56 trade practice conferences acted upon by the Federal Trade Commission, to July 1, 1929. Federal Trade Commission document. 35 cents.

Cyanamid, Its Uses as a Fertilizer Material, by F. E. Allison. U. S. Department of Agriculture Circular 64. 5 cents.

Miscellaneous Publications

Commercial Explosives: Their Safe and Proper Use. Hercules Powder Company Wilmington, Del. 44 pages. Very informative and handy booklet incorporating experience of the company and of the U. S. Bureau of Mines.

Report on Prevention of Industrial Accidents. Report 1. International Labour Conference, 12th session, Geneva, May, 1929. 219 pages. Contains replies of governments to questionnaire, general survey on accident prevention, and conclusion.

Efficiency, Cost, and Safety of Storage-Battery Equipment in Bituminous Coal Mines, and Some Comparisons with Wire Transmission of Power, by C. W. Owings, U. S. Bureau of Mines, and D. C. Jones, Carnegie Institute of Technology. Prepared under the auspices of U. S. Bureau of Mines, Carnegie Institute of Technology, and Mining and Metallurgical Advisory Boards as Co-operative Bulletin 42. This document may be purchased from John D. Beatty, Carnegie Institute of Technology, Pittsburgh, Pa. Price, $2.

THE PLANT NOTEBOOK

an exchange for OPERATING MEN

Acid-Proof Pump for Small Scale Plant

BY H. L. GLAZE
Consulting Engineer, Los Angeles, Calif.

IN SETTING up small-scale apparatus in the laboratory for the first stage in semi-works development of a product a small pump is often needed to circulate or feed accurately very small quantities of liquid. The writer believes that such a pump cannot be purchased, as he has never seen one listed in the catalogs of the laboratory supply houses.

The accompanying sketch shows the construction of one form of such a pump which has been used by the writer for many months in circulating strong sulphur dioxide solution. A method of operating the diaphragms was adopted as being very simple and easily constructed from the materials at hand. Straight-line motion from a crank and crosshead would perhaps have been better mechanically, but the mechanism shown serves very satisfactorily.

Cylinders, *A*, were made from 4-oz. wide-mouth bottles by cutting off the bottoms about $\frac{1}{4}$ in. up, afterward grinding the rough edges of the glass to prevent cutting the rubber diaphragms. The diaphragms, *B*, were made of pieces of old balloon inner tubes stretched over the open bottoms of the bottles and securely fastened with several wraps of strong twine tightly tied. This operation takes four hands, two to stretch the rubber and two to tie it. Rubber stoppers, *C*, each having two holes, were used in the necks of the bottles and were held in place with twine "bridles" secured around the necks of the bottles under the beads.

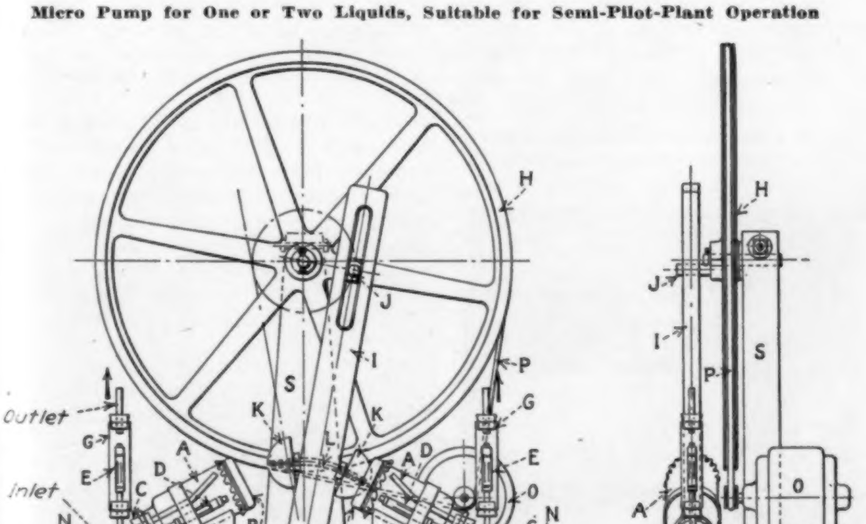
Bunsen valves, *D* and *E*, were made of heavy vacuum rubber tubing with three razor-blade slits or gills. The valves were stoppered at the free ends with short sections of glass rod and both the stoppers and the connecting glass tubing were securely tied to the rubber with twine. Outlet valves, *E*, were inclosed in $\frac{3}{4}$-in. bore glass tubing, *G*, with rubber stoppers securely "bridled."

The drive wheel, *H*, was salvaged from an old sewing machine. A lever, *I*, was made of hardwood, the slot for the crank pin, *J*, being lined with brass. Plungers, *K*, which press on the diaphragms, were rubber stoppers ground to the shape shown and were simply screwed onto the threaded stud, *L*, running through the lever, *I*.

Wooden blocks, *M*, serve as adjustable mounts for the cylinders. The amount pumped per stroke may be regulated by means of the knurled hand wheels, *N*, at each end. This adjustment is quite delicate and ranges from one drop to several cubic centimeters per stroke. The pump will develop about 10 ft. of water head and will suck several feet, depending upon the strength of the diaphragms; the heavier and tighter the rubber the greater the vacuum developed.

The motor, *O*, was a small one of the split-phase type running at 1,800 r.p.m. on 60 cycles. It carried a $\frac{3}{4}$-in. pulley with a $\frac{1}{4}$-in. round belt, *P*. The whole mechanism was mounted upon a wooden base, *R*, with a wooden support, *S*, screwed on to carry the drive wheel.

Micro Pump for One or Two Liquids, Suitable for Semi-Pilot-Plant Operation



It will be evident from the foregoing that the laboratory junk box can be made to yield most of the parts required for the pump. Its details of construction are easily variable to suit individual facilities. Its size, for instance, can be considerably increased or decreased without materially altering the design. And since the two cylinders are separately adjustable, the pump may be used to handle two different fluids.

Follow These Rules When Unloading Tank Cars

BY H. L. KAUFFMAN
Consulting Engineer, Denver, Colo.

UNLOADING of tank cars involves the possibility of certain hazards and losses which may be very nearly eliminated if a proper standard procedure be adopted. The following general rules are those that have been found to be applicable in unloading the usual liquid products from tank cars:

1. Examine the condition of the tank car and of the valve.
2. Make a record of the seal numbers.
3. See that the valve is properly seated before the outlet cap or plug is removed.
4. If, after removing the outlet cap, the outlet chamber is found to be packed in any way whatsoever, the cap should be replaced without removing the packing and the car should be unloaded through the dome by the pump or syphon method.
5. If any shortage exists take measurements from the under surface (inside) of the top shell sheet at the dome opening to the surface of the product, together with the temperature of the liquid at the top, the middle and near the bottom. (Usually a shortage of less than 50 gallons will not be considered by shippers, especially in the case of volatile petroleum products.)
6. If the car arrives without a seal or with the seal broken, or in leaking condition, do not unload it until a railroad representative has inspected the car and made a notation on the freight bill.
7. Determine if the contents of the car is acceptable according to specific chemical or other tests.
8. If not acceptable, notify the person from whom the purchase was made.

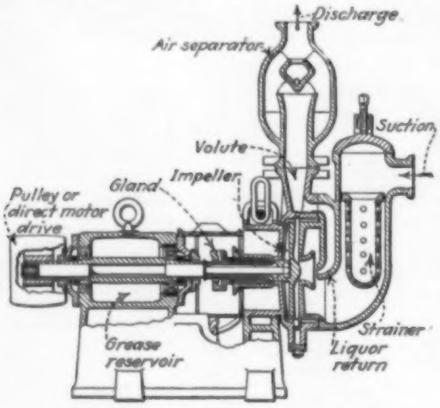
It should be borne in mind that the foregoing rules are general ones, and that the inherent characteristics of a particular product may necessitate additional rules of a special nature.

EQUIPMENT NEWS *from* MAKER *and* USER

Self-Priming Pump

AN ACCOMPANYING drawing shows in partial section a new self-priming centrifugal pump, known as No. 80, which is made by the Duriron Company, Dayton, Ohio. All parts of the pump which come in contact with the liquor being handled are made of Duriron. At a speed of 1,750 r.p.m. the pump handles 60 gal. (sp.gr. 1.0) per minute, against a head of 60 ft.

Main features of the pump are clearly shown in the drawing. An air separator



New Self-Priming Duriron Centrifugal Pump

mounted in the discharge directly above the pump casing serves to return liquid to the suction, in case the suction column is broken. In this manner, once the pump has been primed when it is first installed, sufficient liquid will always remain in the pump to ensure proper starting at any time.

The pump shaft is mounted upon two anti-friction bearings and may be direct-connected to a motor or equipped for belt drive. The shaft where it enters the stuffing box is shrouded with Duriron. A strainer in the suction prevents foreign materials from injuring the impeller. The latter is of the open type to prevent clogging when liquids containing solids are pumped. A plug in the bottom of the volute facilitates draining the pump. A long stuffing box is provided which may be packed with one of several packings made by the company, depending upon the service. A water-seal gland is provided at small additional cost.

New Compressors

A NEW line of compressors which feature Timken roller bearings on the main crankshaft journals is announced by the Worthington Pump & Machinery Corporation, Harrison, N. J. These compressors are of the single-cylinder, horizontal, straight-line type, with capacities ranging from 100 to 300 cu.ft. per minute. Standard equipment includes an oil-tight crankcase, feather valves, and a pressure unloader.

Potentiometer Recorder

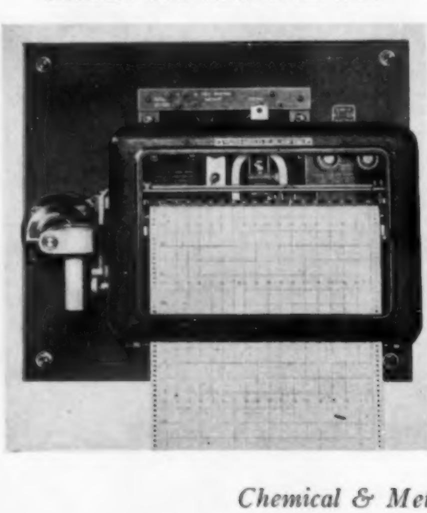
A NEW pyrometer recorder of the null potentiometer type has been developed by Wilson-Maeulen Company, 383 Concord Avenue, New York. An important feature is that the 12-inch strip chart used for recording temperature is said to be the widest employed by any manufacturer.

The new instrument uses a null potentiometer as the measuring device. The potentiometer circuit must be brought into balance, so that no current passes through the galvanometer, when the temperature is recorded. This is accomplished automatically. When the voltage generated by the thermocouple changes as a result of temperature change at the furnace, the galvanometer pointer deflects in a corresponding direction. At short intervals, a boom descends and grips the pointer firmly while two sensing fingers, moving in a vertical plane, approach the pointer from each side, exploring for the location of the pointer. If either finger finds the pointer deflected, and away from its center or null position, a roller ratchet dog is released by the finger, causing a drum to turn.

A violin string, wound around the drum and passing over pulleys on each side of the chart, communicates rotation of the drum to a carriage, causing it to travel back and forth across the whole instrument. The carriage carries a pen which marks the chart in its travel, and a contact brush that rides on the potentiometer slide wire.

In operation, when the thermocouple emf. changes, the instrument automatically rotates the drum and moves the brush on the slide wire until the galvanometer is in balance. At the same time, the pen moves across the chart to the location corresponding to the new temperature. The speed of the chart may be varied in three steps, from ¾ in. to 3 in. per hour, enabling the user to secure the speed most suited to his needs.

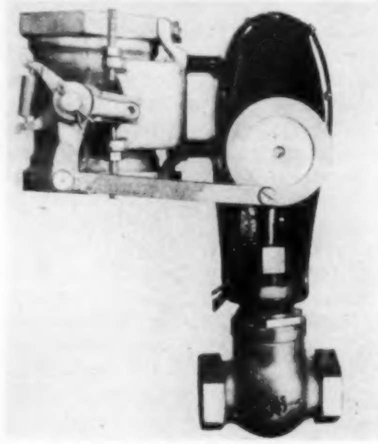
Model 8201 Potentiometer Pyrometer Recorder Uses Chart 12 In. Wide



The instrument is provided with an external drive unit, for 110 or 220 volts, alternating current. This unit provides power sufficient to operate from one to three instruments; one or more of these instruments may be an automatic control pyrometer made by this company.

Industrial Regulators

A NEW LINE of industrial regulating equipment is now being produced by the Minneapolis-Honeywell Regulator Company, Minneapolis, Minn. This includes equipment for the con-



Type V-20-1 Industrial Motor Valve Combines Globe and Butterfly Valves for Simultaneous Regulation of Fuel and Air Supply or Similar Uses

trol of temperature, pressure and combustion. It comprises motor valves, pressure and thermostatic equipment, and devices for safeguarding combustion equipment in the event that oil or gas fires should be extinguished, or other circumstances arise.

In the line of industrial motor valves is included equipment operating one globe valve, one globe valve and one butterfly valve, or two globe valves. Butterfly valves are also operated alone. Motor valves are obtainable in globe valve sizes from ½ to 3 inches, with or without a butterfly valve of 2 to 6 inches, operated simultaneously. In each type the motor operates a cam through a train of spur gears so as fully to open or close the valve being controlled. A ratchet device makes possible manual control of the valve at any

time without disturbing the electrical control feature.

The line also includes motor and magnetic valves for shutting off oil or gas in heating installations.

Controlling instruments are provided in the form of temperature and pressure regulators of the mercury switch type. The temperature regulators make use of a bimetallic operating element arranged to be inserted in the vessel under control. The element is coupled through the adjusting mechanism, whereby the control temperature is set, to a mercury switch. The pressure controllers make use of a metallic bellows or a composition diaphragm to actuate a mercury switch. These are also adjustable to various control points.

The combustion controllers are of three types. One instrument contains a diaphragm which is deflected when radiation from a furnace flame decreases, as when the fire is extinguished. It may then close valves or operate signals. Another type is adapted to control combustion, dependent upon flue gas temperature. This employs a bimetallic spiral to make electrical contacts. These devices may be used to control valves or operate alarms in the event that the temperature goes too high or too low. The third device employs a vapor pressure thermometer system to open a snap switch in case temperature goes too high.

Using this equipment and other apparatus previously developed in connection with building heating, the company has worked out methods for controlling unit heaters. These methods include individual and group control, with or without master clock regulation.

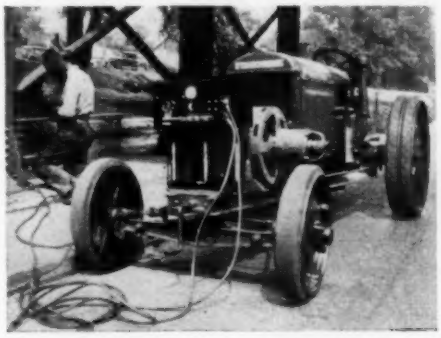
Inclosed Motors

A NEW LINE of inclosed motors which are said to be explosion and abrasion-proof has been introduced by the Armor Electric Manufacturing Company, Erie, Pa. These motors range in size from $\frac{1}{2}$ to 50 hp., 220-550 volts, 2 and 3 phases and 25 and 60 cycles. They are of the fully-inclosed squirrel-cage induction type with grease-sealed shafts and an internal fan to promote cooling. The motors are equipped with Timken roller bearings and are recommended for service in explosive fumes and abrasive dust.

New Armor Explosion-Proof Motor

Acetylene Generator

A LIGHT-WEIGHT acetylene generator for welding and cutting, which employs a body made entirely of drawn seamless steel, has been announced by the Alexander Milburn Company, Baltimore, Md. The generator is of the type in which carbide is fed from a hopper by means of a valve which responds to the pressure in the generator, feeding carbide when the pressure is low and stopping the feed if the pressure is high. Safety features are incorporated to protect the machine in case it tips over. A special blow-off valve, pressure control, safety gas purifier and strainer are all standard equipment. It is claimed that the cost of gas made with this generator is $1\frac{1}{8}$ cents per cu.ft. as compared with $2\frac{1}{4}$ to 6 cents per cu.ft. for gas in cylinders.



Combination of Lincoln Welder and McCormick-Deering Tractor

Mobile Welder

A RECENT development of the Pontiac Tractor Company, Pontiac, Mich., is a Lincoln Stable Arc welder mounted on a McCormick-Deering tractor. The unit is furnished in 200 and 300 amp. sizes. The large size tires used permit a road speed of 15 miles per hour.

Unbreakable Resistor

A NEW resistor known as "Durristor" has been announced by Cutler-Hammer, Milwaukee, Wis. The resistant element consists of two continuous unbreakable strips of alloy, which are supported so as to permit of free expansion and contraction during temperature changes. Mica is the material used for all insulation.

All of the resistors of the new line are of equal size. The thickness of the resistance strip is the only variable dimension and is suited to the various ratings.

Partially Inclosed Motor

TO MEET the demand for protected motors, not however fully inclosed, the U. S. Electrical Manufacturing Company, Los Angeles, Calif., has introduced what is known as the "Uniclosed" motor. The motor is of the asbestos-protected type sponsored by this company and embodies a solid die-cast aluminum rotor and ball bearings. Protection is provided for moving parts and for the electrical winding. Ventilation is furnished by the employment of a dual blast of air induced toward the center from the ends by two fans located at opposite sides of the rotor. Heated air is expelled at both sides of the motor through exhaust louvres. The internal parts are shielded from water and against dust and other abrasive substances.

New Recording Instruments

RECENT developments announced by the Brown Instrument Company, Philadelphia, include a special manometer, Model 254, designed for use as a flow meter for steam pressures up to 1,500 lb. per square inch. This manometer, like those which the company has been producing for some time, makes use of the inductance bridge principle of transmitting indications to the recorder or indicating instrument.

A second development makes available recorders for flow and other variables in the flush type of strip recorder. The flow meter recorders have previously been of the round chart type.

A third development extends the use of the inductance bridge principle to a motion transmitter adapted for indicating, recording or controlling various factors at long distances. This instrument has been applied to the measurement and controlling of pressure, flow, liquid level and special data involving the position or motion of various equipment.

5-gallon Wax Pot With Agitator and Electrically Heated Spigot

Electrically Heated Pots

TWO small pots, electrically heated and controlled, have been announced by the Harold E. Trent Company, 439 North Twelfth St., Philadelphia, Pa. These are of five gallons capacity, adapted to operate on $1\frac{1}{2}$ kw. at 110 or 220 volts. One form of kettle is equipped with a thermostat for controlling the temperature between 100 and 500 deg. F. The second type, illustrated herewith,

makes use of a 3-heat switch and an electrical agitator. Each employs an electrically heated spigot to prevent the contents from freezing as it emerges from the pot.

New Alloy Pipe

A SPECIAL nickel-chromium alloy cast iron is being used in the production of "Arco Metal" pipe, made by the American Radiator Company, 40 West 40th St., New York. The new pipe is produced by a special casting process, which is said to give it greater ductility and tensile strength, and much better corrosion and erosion resisting qualities than ordinary gray cast iron.

The manufacturers state that it is possible to cut and thread the pipe with ordinary tools. It may also be welded through the use of an efficient cast iron weld recently developed. Thus, while the pipe is regularly furnished in 6-ft. lengths, it can be welded to any desired length.

Each length of pipe is tested by the manufacturer from 300 to 1,000 lb. hydrostatic pressure. The pipe is available in sizes from 1½ to 6 in. i.p.s., but sizes 8 to 12 in. are to be produced later.

General Utility Spray

A NEW all-purpose spray painting and finishing outfit known as the Binks New Hurley Unit has been developed by the Binks Manufacturing Company, 3114 Carroll Ave., Chicago, Ill. The unit is equipped with a one-quart paint container and is powered

General Utility Paint Spray Outfit

by means of a ¼-hp. motor. The air capacity is 2.16 cu.ft. per min. Standard equipment includes a 10-ft. electric cord and 10 ft. of rubber hose for attaching the compressor to the spray.

Manufacturers' Latest Publications

Blowers. Connersville Blower Co., Connersville, Ind. — Bulletin 123 — Describes Types RSB and RBB blowers for medium capacities at pressures up to 10 lb.

Buildings. The Korfund Co., 235 East 42d St., New York, N. Y.—Vol. 1 No. 1—First issue of a new publication, "Isolation," devoted to soundproofing and the isolation of machine vibration.

Buildings. Processed Lumber Co., Elizabeth, N. J.—Two folders describing "Awlcoized" lumber, stressing the necessity for making roof repairs before cold weather sets in.

Cements. Quigley Furnace Specialties Co., 56 West 46th St., New York, N. Y.—Form AP 122—24-page booklet describing application and uses of Quigley acid-proof cement.

Chemicals. Vanadium Corp. of America, 120 Broadway, New York, N. Y.—Catalog 2—Catalog and price list of metals, and compounds of vanadium, chromium, molybdenum, titanium, tungsten, and zirconium.

Disintegration. Pittsburgh Plate Glass Co., Bramley Mill Division, Milwaukee, Wis.—Booklet describes Bramley mills for grinding paint, enamel, and lacquer.

Disintegration. Raymond Bros. Impact Pulverizer Co., 1304 No. Branch St., Chicago, Ill.—Folder briefly describing principal types of pulverizing equipment made by this company.

Disintegration. Smith Engineering Works, Milwaukee, Wis.—Bulletin 226F—Describes crushers, sizing equipment, washers, conveyors, feeders, and storage equipment for crushed rock; 27 pages.

Electrical Equipment. Century Electric Co., 1806 Pine St., St. Louis, Mo.—Bulletin 6-1—Describes Type SCN squirrel-cage induction polyphase motors. Also Bulletin 13-1: Type SC squirrel-cage induction polyphase motors.

Electrical Equipment. Columbia Electric Mfg. Co., 1292 East 53rd St., Cleveland, Ohio.—Generators for electroplating and electrochemical processes. Also folder on cast grid tank rheostats for control of plating current.

Electrical Equipment. Crouse-Hinds Co., Syracuse, N. Y.—Catalog 2200—General catalog, 280 pages, on condulets, groundulets, plugs, and receptacles.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-70A, mine type locomotives; GEA-104A, cartridge-type electric heating units; GED-294, welding and fabricating buildings; GEA-556C, automatic welding head and control; GEA-569C, constant potential arc-welding sets; GEA-704B, oil circuit breakers; GEA-834A, controllers for wound-rotor a.c. induction motors; GEA-948A, magnetic controllers for constant-speed motors; GEA-1006B, concentrated system control; GEA-1162, pressure governors; GEA-1174A, conveyor furnace.

Electrical Equipment. Louis Allis Co., Milwaukee, Wis.—Bulletin 508—Describes principle and illustrates applications of type E "Explosion-proof" self-ventilated motors from ¼ to 25 hp.

Electrical Equipment. Roth Brothers & Co., 1400 West Adams St., Chicago, Ill.—Bulletin 20-301—Describes motor-generator sets of various types.

Electrical Equipment. U. S. Electrical Mfg. Co., 200 East Slauson Ave., Los Angeles, Calif.—Form No. F595—Describes new "Uniclosed" motor, a semi-inclosed motor for dusty atmospheres.

Evaporation. Swenson Evaporator Co., Harvey, Ill.—Article VII of a series of ten by Prof. W. L. Badger on "Heat Transfer and Crystallization." This article, 8 pages, treats of the principles of forced circulation evaporation.

Fans. Bayley Blower Co., 732 Greenbush St., Milwaukee, Wis.—Catalog 29-P, Plexiform fans; Catalog 29-B, type B exhaust fans.

Filtration. Johns-Manville Corp., 292 Madison Ave., New York, N. Y.—Form FA-1A—Uses, results and advantages of using Celite filter aids; 19 pages.

Heating and Conditioning. Bayley Blower Co., 732 Greenbush St., Milwaukee, Wis.—Catalog 29-C, Chinookfin heaters; Catalog 29-A, Turbo air washers and conditioners.

Instruments. American Radiator Co., Accessories Division, 40 West 40th St., New York, N. Y.—Bulletin 6—Describes No. 848, Model DMS Mercoid control for unit heaters.

Instruments. Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland, Ohio.—Bulletin 12—Briefly descriptive of all instruments made by this company. Bulletin 110: Selsyn-operated devices for remote indication and record of such factors as flow, pressure, etc.

Instruments. Brown Instrument Co., Philadelphia, Pa.—"Why You Should Use Flowmeters," 32 pages well illustrated on the use of flowmeters in steam generation.

Instruments. Esterline-Angus Co., Indianapolis, Ind.—Bulletins 929 and 1029—Concerning respectively the use of speed recorders, and continuous inspection with graphic instruments.

Instruments. Fulton Sylphon Co., Knoxville, Tenn., Bulletin 150—Describes automatic temperature control of refrigerating systems.

Instruments. Minneapolis - Honeywell Regulator Co., Minneapolis, Minn.—Catalog of a new line of industrial regulators made by this company for controlling temperatures, pressures, and combustion, including motor valves and controllers.

Instruments. C. J. Tagliabue Mfg. Co., 18-33d St., Brooklyn, N. Y.—Bulletin describing new round-form flush and wall type recorders.

Map. Missouri Pacific Railroad Co., St. Louis, Mo.—Wall map showing distribution of agricultural and mineral raw materials for chemical processes along the lines and connections of the Missouri Pacific Railroad.

Material Handling. Cleveland Crane & Engineering Co., Wickliffe, Ohio.—Publications as follows: G2-29, Tramrail Scales; RO 129, Roll Handling; PR 161-29, Handling Make-up Orders; PR 19129, Tramrails in Auto Industries.

Material Handling. Lewis-Shepard Co., 174 Walnut St., Watertown Sta., Boston, Mass.—Engineering Edition 57—"Jacklift and Stacker Practice," describing hand trucks, stackers, and skid platforms. Also Circular 100, describing a new foot-lift hand truck for loads up to 3,500 lb.

Metals and Alloys. Downington Iron Works, Downingtown. Pa.—24-page book, illustrated, on chromium alloys for general fabrication.

Metals and Alloys. International Nickel Co., 67 Wall St., New York, N. Y.—"Meeting the Metal Requirements of the Process Industries," corrosion data on nickel and Monel metal with very complete list of corrosive agents handled in contact with these metals. It is pointed out that the uses given are all definitely established.

Metals and Alloys. New Jersey Zinc Co., 160 Front St., New York, N. Y.—Bulletin on zinc-base die-casting alloys.

Mixing. Robinson Mfg. Co., Muncy, Pa. — Folder 211 — Briefly describing mixing equipment for liquids, pastes, and dry materials.

New Orleans. New Orleans Association of Commerce, New Orleans, La.—"A Statement of Facts Concerning New Orleans, La., as a Suitable Location for Chemical Industries," a booklet prepared by J. F. Coleman Engineering Co., discussing conditions relating to the chemical industry in the New Orleans area.

Piping. Tube-Turns, Inc., Louisville, Ky.—Bulletin 104—20 pages, well illustrated, describing pipe welding with stock fittings in the process industries.

Power Transmission. New Departure Mfg. Co., Bristol, Conn.—Description and data concerning new N-D-Seal ball bearings.

Power Transmission. Westinghouse Electric & Mfg. Co., Nuttall Works, Pittsburgh, Pa.—Folder 5223—Briefly describes Westinghouse Nuttall heat-treated and hardened gears.

Pumps. The Duriron Co., Dayton, Ohio.—Bulletin 155—Describes Duriron centrifugal pumps Nos. 75 and 80. No. 80 pump is self-priming.

Pumps—Taber Pump Co., 288 Elm St., Buffalo, N. Y.—Publications as follows: Bulletin R-929, Type R rotary pumps; also brief description of other rotary pumps. Bulletin SP-428, standard sump pumps from 10 to 100 g.p.m.; supplement to Bulletin SS-629, rating table for sump pumps.

Safety. Bullard-Davis, Inc., 67 Wall St., New York, N. Y.—Bulletin 801—Describing non-rigid hats for industrial head protection.

Safety. Mine Safety Appliances Co., Pittsburgh, Pa.—Catalog No. 4—160-page catalog describing safety lamps, masks, gas detectors, first aid and plant hospital equipment, respirators, safety clothing and other safety equipment for mines and industrial plants.

Steam Generation. Combustion Engineering Corp., 200 Madison Ave., New York.—Catalog GND-2—Describing Green chain grate stokers for natural draft.

Steam Generation. Schutte-Koerting Co., Philadelphia, Pa. — Booklet 1 — Condensed description of equipment for steam power plants made by this company, including burners, heaters, pumps, strainers, valves, condensers, vacuum equipment and so on.

Testing. Pittsburgh Testing Laboratory, Pittsburgh, Pa.—Brochure entitled "Science—Aid to Modern Business," describing necessity for testing products as an aid to production and marketing.

Valves. Chapman Valve Mfg. Co., Indian Orchard, Mass.—Catalog 61—General catalog and price list covering most of the products of this company; 257 pages. Also catalog describing sluice gates, foot valves, and check valves made by Coffin Valve Co., for which this company is sales agent. Also folder on Nitralloy for valve mountings.

Welding. Fusion Welding Corp., 103d St. and Torrence Ave., Chicago, Ill.—Descriptive Bulletin 4—Deals with Weldite Type S welding rod for chrome-nickel alloy steels and similar alloys.

Welding. Linde Air Products Co., 30 East 42d St., New York, N. Y.—Well illustrated, 67-page handbook on "Design Standards for Oxwelded Steel and Wrought Iron Piping."

PATENTS ISSUED

Oct. 1 to Oct. 22, 1929

Paper, Pulp and Sugar

Process of Making Paper and Product Thereof. Arthur L. Kennedy, Keene, N. H., assignor to Plastic, Inc.—1,730,009.

Process of Conditioning Cellulosic Material for Preparation for Cellulose Derivatives and Product of Same. George A. Richter, Milton O. Schur, and Royal H. Rasch, Berlin, N. H., assignors to Brown Company, Berlin, N. H.—1,729,628-9.

Bleached Chemical Wood Pulp and Process of Making. Linn Bradley, Montclair, N. J., and Edward P. McKeefe, New York, N. Y., assignors to Bradley-McKeefe Corporation, New York, N. Y.—1,730,315.

Cyclic Process of Fiber Liberation. George A. Richter, Berlin, N. H., assignor to Brown Company, Berlin, N. H.—1,730,-383.

Process of Refining Pulp. Milton O. Schur, Berlin, N. H., assignor to Brown Company, Berlin, N. H.—1,730,386-7.

Production of Cellulose from Highly Lignified Plants. Roland Runkel, Mainz-Mombach, Germany, assignor to Verein für Chemische Industrie Aktiengesellschaft, Frankfort, Germany.—1,731,112.

Method of Refining Sugar. Eugene N. Ehrhart, New Orleans, La., assignor to John J. Naugle, Brooklyn, N. Y.—1,731,237.

Process of Carbonizing the Organic Constituents of Sulphite Cellulose Lye. Carl Gustav Schwalbe, Eberswalde, Germany.—1,731,354.

Non-Deliquescent Product from Sulphite Waste Liquor. Paul Onnertz, Berlin-Wilmersdorf, and Hans Wesche and Karl Brodersen, Dessau, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort, Germany.—1,731,433.

Paper Dryer. Stephen B. Stafford, Oxford, and John Warren Vedder, Worcester, Mass., assignors to Rice, Barton & Fales, Inc., Worcester, Mass.—1,731,876.

Process and Apparatus for Making Paper. Melvin R. Ware, Baltimore, Md.—1,732,176.

Manufacture of Products Having a Basis of Cellulose Derivatives. Camille Dreyfus, New York, N. Y., and George Schneider, Cumberland, Md., assignors to Celanese Corporation of America.—1,732,330.

Sugar Product and Method of Making Same. Viggo Valdemar Julius Andresen, Oslo, Norway.—1,732,492.

Rubber, Rayon, and Plastics

Manufacture of Rubber. Ernest Alfred Hauser, Frankfort-on-the-Main, Germany, assignor to K. D. P. Limited, London, England.—1,729,651.

Reclaimed Rubber. Charles H. Campbell, Pittsburgh, Pa., assignor to American Glue Company, Boston, Mass.—1,729,706-8.

Rubber Composition. Charles H. Campbell, Pittsburgh, Pa., assignor to American Glue Company, Boston, Mass.—1,729,709.

Method of Making Rubber Compositions. Merwyn C. Teague, Jackson Heights, N. Y., assignor to Naugatuck Chemical Company, Naugatuck, Conn.—1,730,485.

Process for Treating Rubber Dispersions and Products Obtained Thereby. John McGavack, Jackson Heights, N. Y., assignor to Naugatuck Chemical Company, Naugatuck, Conn.—1,730,518.

Liquid Coating Composition. Gerald H. Mains, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company.—1,730,857.

Method of Preparing a Synthetic Resin Varnish. Gustave E. Landt and William H. Adams, Jr., Norristown, Pa., assignors, by mesne assignments, to Continental-Diamond Fibre Company, Newark, Del.—1,731,071-2.

Process and Apparatus for the Manufacture of Artificial Silk and Like Threads. Charles Wilfred Palmer and William Whitehead, Spondon, near Derby, England, assignors to Celanese Corporation of America.—1,731,317.

Rubber Composition and Method of Making and Shaping the Same. Harry L. Fisher, Leonia, N. J., and William C. Geer, New Rochelle, N. Y., assignors to B. F. Goodrich Company, New York, N. Y.—1,731,483-8.

Artificial Leather Sheeting and Method of Making the Same. Thomas G. Richards, Cambridge, Mass., assignor to Dispersions Process, Inc., Dover, Del.—1,731,754.

Method of Producing Rubber Compositions Having Low-Moisture Absorption. William C. Geer, New Rochelle, N. Y., and Harry L. Fisher, Leonia, N. J., assignors to B. F. Goodrich Company, New York, N. Y.—1,731,849.

Aqueous Rubber Dispersion. William Beach Pratt, Wellesley, Mass., assignor, by mesne assignments, to Dispersions Process, Inc., Dover, Del.—1,732,027.

Method of Making Plastic Compounds. Thomas Robinson, New York, N. Y., assignor to Lancaster Asphalt, Inc., New York, N. Y.—1,732,281.

Nitrobenzene-Sulphur Resin and Method of Making Same. William C. Wilson, Chicago, Ill., assignor, by mesne assignments, to Cutler-Hammer, Inc.—1,732,453.

Cold-Molded Plastic-Composition Article and Method of Making the Same. Frank Kurath, Milwaukee, Wis., assignors, by mesne assignments, to Cutler-Hammer, Inc. 1,732,478.

Petroleum Refining and Products

Separation of Olefines from Petroleum Products. Robert M. Isham, Okmulgee, Okla., assignor, by mesne assignments, to Seth B. Hunt, trustee, Mount Kisco, N. Y. 1,729,782.

Manufacture of Lubricants. Howard Vimmig, Port Arthur, Texas, assignor, by mesne assignments, to Texas Company, New York, N. Y.—1,729,823.

Treatment by Pressure and Heat of Heavy Mineral Oils and Carbon Material. Max Hofsäss, Mannheim-Neckarau, Germany, assignor to the Firm Internationale Bergin-Compagnie voor Olieen Kolen-Chemie s'Gravenhage, Gravenhage, Netherlands.—1,729,943.

Distillation Apparatus. Arman E. Becker, Newark, and Jackson R. Schonberg, Westfield, N. J., assignors to Standard Oil Development Company.—1,730,112.

Art of Obtaining Gasoline Hydro-Carbons. Warren K. Lewis, Newton, Mass., assignor to Standard Oil Development Company.—1,730,152.

Apparatus for Condensing Hydro-Carbon Vapors. John E. Bell, deceased, Brooklyn, N. Y., by Lola R. Bell, executrix, Brooklyn, N. Y., assignor to Sinclair Refining Company, New York, N. Y.—1,730,350.

Process of and Apparatus for Distilling Petroleum. Eugene H. Leslie and Edwin M. Baker, Ann Arbor, Mich.—1,730,891-2.

Process of Removing Oil from Mineral-Oil-Sulphonic Bodies. Charles Fischer, Jr., and Warren T. Reddish, Cincinnati, Ohio, assignors to Twitchell Process Company, Cincinnati, Ohio.—1,731,716.

Process of Removing Amorphous Wax from Petroleum Oils. Pierce Mason Travis, Ridgewood, N. J., assignor to Travis Process Corporation, Jersey City, N. J.—1,732,-143-4.

Coal and Organic Processes

Soap Preparation. Fritz Günther and Joseph Nüsslein, Ludwigshafen-on-the-Rhine, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort, Germany.—1,730,037.

Process for Production of Urea. Harry C. Hetherington, Washington, D. C., and Herbert J. Krase, Clarendon, Va.—1,730,-208.

Apparatus for Extracting Values from Coal and Like Materials. Frank C. Greene, Denver, Colo., and Irving F. Laucks, Seattle, Wash., assignors to Old Ben Coal Corporation, Chicago, Ill.—1,730,569.

Coke-Oven Apparatus. George T. Bruun, Pittsburgh, Pa., assignor to Koppers Company.—1,730,602.

Method for Converting Solid Carbon into Liquid Hydrocarbons. Paul Danckwardt, Alhambra, Calif.—1,730,997.

Method of and Apparatus for the Distillation of Carbonaceous Material. Otto H. Hertel, Chicago, Ill.—1,731,165.

Wood Distillation. Franklin S. Clark, Palm Beach, Fla.; L. Yancey Clark and Franklin S. Clark, jr., executors of said Franklin S. Clark, deceased.—1,731,242.

Lacquer. Joseph G. Davidson, Yonkers, N. Y., assignor to Carbide & Carbon Chemicals Corporation.—1,731,333.

Method of Treating Carbonaceous Material in an Electric Furnace or the Like. John J. Naugle, Brooklyn, N. Y.—1,731,473.

Apparatus for Discharging Vertical Retorts. Francis Bartlett Richards and James Wilson Reber, London, England.—1,732,064.

Gas Scrubber. John P. Flippen, Pittsburgh, Pa.—1,732,086.

Process of Making Ethylene Glycol Monoalkyl Ethers. Joseph George Davidson, Yonkers, N. Y., assignor to Carbide & Carbon Chemicals Corporation.—1,732,356.

Process for Splitting Hydrocarbons. Otto Schmidt, Otto Grosskinsky, and Georg Niemann, Ludwigshafen-on-the-Rhine, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort, Germany.—1,732,381.

Manufacture of Esters. Rudolf Wietzel, Ludwigshafen-on-the Rhine, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfort, Germany.—1,732,392.

Inorganic Processes

Electrodeposition of Chromium. Rudolph Auerbach, Probstdeuben, near Leipzig, Germany, assignor, by mesne assignments, to Chromeplate, Inc., Union City, N. J.—1,730,349.

Process of Producing Phosphorus Chloride from Phosphate Rock. Claude G. Miner, Berkeley, Calif.—1,730,521.

Extraction of Hydrogen from Gaseous Mixtures. Georges Claude, Paris, France, assignor to La Société l'Air Liquide, Société Anonyme pour l'Etude et l'Exploitation des Procédés Georges Claude, Paris, France.—1,730,805.

Method of Recovering Iodine. Edmund Kurek, Chippewa Falls, Wis.—1,731,309.

Process for the Production of Clear Leach Liquors. Arthur W. Allen, Berkeley, Calif.—1,731,450.

Method for Filtering Sulphur. Arthur J. Crowley, Sulphur, Nev., assignor to Humboldt Sulphur Company, Sulphur, Nev.—1,731,562-3.

Alloy and Process of Heat Treatment. Michael G. Corson, Jackson Heights, N. Y., assignor to Electro Metallurgical Company.—1,732,327.

Catalytically Manufacturing Phosphoric Acid and Hydrogen. Alwin Mittasch and Gustav Wietzel, Ludwigshafen-on-the-Rhine, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort, Germany.—1,732,373.

Process of Making White Lead. Edward C. Walker, St. Louis, Mo., assignor to National Lead Company, St. Louis, Mo.—1,732,490.

Chemical Engineering Processes and Equipment

Pressure Regulation. Grant Campbell, Short Hills, N. J., assignor to Campbell Engineering Company, Newark, N. J.—1,729,819-20.

Apparatus for Spray Drying Liquid Materials. Paul T. Zizinia, Belmar, N. J.—1,730,048.

Method and Apparatus for Separating Materials of Different Specific Gravities. Henry M. Chance, Philadelphia, Pa.—1,730,123.

Apparatus for Separating Materials of Different Specific Gravities. Henry M. Chance, Philadelphia, Pa.—1,730,189.

Universal Plug Valve. George Stancu, Jr., Philadelphia, Pa.—1,730,305.

Vibratory Screen. Alexander L. Munro, Milwaukee, Wis., assignor to Smith Engineering Works, Milwaukee, Wis.—1,730,435.

Heating and/or Chemical Treatment of Liquids and Molten Materials by Direct Contact with Combustion Products. Stanley Cochran Smith, London, England.—1,730,440.

Method of and Means for Drying. John M. Rugh, Elizabeth, N. J., assignor to American Cyanamid Company, New York.—1,730,902.

Process for the Improvement of the Manufacture of Cement from Slag. John G. Bergquist, New York, N. Y.—1,731,189.

Apparatus for Effecting Contact Between Gases and Divided Solids. Edward J. Brady, Philadelphia, Pa., assignor to United Gas Improvement Company, Philadelphia, Pa.—1,731,223.

Process of Conducting Chemical Reactions. Glen D. Bagley, Flushing, N. Y., assignor to Carbide & Carbon Chemicals Corporation.—1,731,331.

Apparatus for Treating Clay. John C. Black, Los Angeles, Calif., assignor, by mesne assignments, to Contact Filtration Company, San Francisco, Calif.—1,731,702.

Grinding Mill. Charles E. Needham, Allentown, Pa., assignor to Bethlehem Foundry & Machine Company.—1,731,788.

Conveying Mechanism. Robert K. Jeffrey, Columbus, Ohio, assignor to Jeffrey Manufacturing Company, Columbus, Ohio.—1,732,365.

Process for Treating, Impregnating, and Stabilizing Wood. George Elton Rice, Brooklyn, N. Y., assignor, by direct and mesne assignments, to Conservation Corporation of America.—1,732,419-20.

NEWS of the Industry

A.I.Ch.E. Completes Plans For Asheville Meeting

FINAL arrangements have been completed for the annual meeting of the American Institute of Chemical Engineers, which will be held in Asheville, N. C., Dec. 2-4 inclusive. Important business in connection with certain changes that have been proposed in the Institute organization and policies will be transacted at the annual business meeting.

In keeping with the industrial environs of the district, the technical sessions will deal with the general theme of chemical engineering and cellulose—more specifically, in its relation to the pulp and paper and the textile and rayon industries. In addition to the two symposia, several miscellaneous papers will discuss problems presented in the growth and development of other chemical engineering industries of the Southern states.

In the pulp and paper symposium two papers dealing with different phases of drying operations will be presented by T. K. Sherwood, of Worcester Polytechnic Institute, and F. W. Adams and C. M. Cooper, of M.I.T., Clark C. Heritage, of the Oxford Paper Company, and C. E. Curran, of the Forest Products Laboratory, will review research trends in this field. C. L. Wagner, of New York, will discuss recovery of byproducts.

The textile symposium will include a number of papers on the relation of chemical engineering to the processing of cotton, silk and rayon. Prof. C. E. Mullin, of Clemson College; Prof. A. H. Grimshaw, of N. C. State College; W. F. Edwards, of the U. S. Testing Company; C. D. Blackwelder, of the J. E. Sirrine Company, are to be among the speakers.

MISCELLANEOUS subjects of chemical engineering interest will be discussed by Percy C. Kingsbury, of the General Ceramics Company; H. E. Nash and E. A. Georgi, of Hercules Powder Company, and others interested in chemical developments in the South.

Industrial trips will include an extended inspection of the plant of the Champion Fibre Company at Canton, N. C. Other plants to be visited will include the Hans Rees Tannery in Asheville, the Sayles-Biltmore Bleachery, and the cotton and wool blanket plant of the Beacon Manufacturing Company at Swannanoa. Arrangements can also be made for visits after the convention to inspect chemical industries at Kingsport, Tenn., and other important industrial centers near by, as well as the chemical engineering departments of the University of North Carolina at Chapel Hill, and the North Carolina State College at Raleigh.

Gas Association Holds Annual Convention

APPROXIMATELY 6,000 members and guests of the American Gas Association participated in the annual meeting of this national organization held during the week of Oct. 14 at Atlantic City. Housed in the new auditorium of that community, the convention carried out the largest exhibit of gas appliances and gas-making equipment which has ever been presented.

Reports of the officers, particularly of Managing Director Alexander Forward, showed that the industry as a whole, and the association in particular, are in a very prosperous condition. Major Forward pointed out that the revenues of the gas industry increased by 8 per cent, its customers were more numerous by 500,000, and the send-out had increased by nearly 9 per cent during the past year as compared with the one preceding. It is also shown by the statistical service of the association that in 1928 operating expenses per M sold were nearly 4c. less than in the preceding year. This saving was approximately equally divided between a lowering of the average price of gas to customers and an increased allotment to dividends or surplus.

The officers selected to head the association for the coming year include: President, Bernard J. Mullaney, Peoples Gas Light & Coke Company, Chicago; vice-president, Clifford E. Paige, Brooklyn Union Gas Company, Brooklyn; and treasurer, William J. Welsh, New York and Richmond Gas Company, Staten Island. The officers selected by the Technical Section to direct affairs for the period 1929-30 were: Chairman, B. V. Pfeiffer, United Gas Improvement Company, Philadelphia; and vice-chairman, R. G. Griswold, Cities Service Company, New York City.

The Charles A. Munroe Medal award, which is presented annually by the A.G.A. for outstanding service to the industry, was this year presented to Nils T. Sellman, assistant to the vice-president in charge of sales of the Consolidated Gas Company, of New York City. This award was made to Mr. Sellman for his outstanding service in the further development of the gas refrigerator.

Akron Section Discusses Tire Problems

THE Akron Rubber Section of the American Chemicals Society held its first meeting of the new season on Oct. 14. The success of the meeting was largely due to the B. F. Goodrich Company, which furnished the hall and served an excellent dinner. About 350 members and their guests attended the meeting and represented practically every engineering profession connected with the rubber industry. Among the out-of-town guests attending the meeting was Dr. Ernest Hauser, of Frankfort, Germany, who made a few remarks and invited the members of the group to visit the meeting of the Rubber Technologists of Germany, to be held in Frankfort, in June, 1930.

In the first of the three addresses on the program, Clarence Morr, of the Firestone Steel Products Company, gave a very interesting discussion concerning the design of rims. A number of slides were shown illustrating some of the problems and the solutions which have been found. The speaker pointed out that lack of standardization in wheels has complicated the problem of designing rims, and has made necessary a large number of mountings which might be eliminated.

The second speaker, Mr. Smithers, recounted some of his observations and experiences in connection with tire analysis and design. Slides were presented showing sectional heights and cross-section measurements of round, high, and flat carcass tires. He pointed out that 10 deg. cord angle differences were observed at the crown in tires made by different companies. A crown angle of 39 deg. or 40 deg. is the mean between the extremes used by some of the most reputable manufacturers, and was recommended by Mr. Smithers on that basis. His paper was concluded with an interesting discussion of tread contours.

J. C. Sproull, of the B. F. Goodrich Company, concluded the meeting with a paper on indoor and outdoor tire testings. He described the type of laboratory machine in common use; its operation, results obtained, and limitations. Next he took up outdoor testings, bringing out quite fully its difficulties and limitations. The paper closed with a comparison of the costs of indoor and outdoor tests, stating that outdoor testings may cost as much as 50 times that of indoor testings.

Officers will be elected at the next meeting of the group, which will be held early in December.

Twenty-Six Countries Answer Convocation Of Engineers to Congress in Japan

By Special Correspondence

ONE MORE successful step in the promotion of international contact throughout the technical professions is under way at the World Engineering Congress at Tokyo, perhaps the most ambitious program of its kind that ever has been attempted. Representing the best technical talent of the principal nations, more than three hundred professional men have made the long journey to Japan from all portions of the globe in addition to the many Japanese engineers and foreign residents in Japan who are in attendance.

The calling of this convocation by the Japanese government has the deeper significance that, six years after an earthquake, which was the greatest natural disaster in modern times, Japan is ready to show an engineering and economic progress which the catastrophe has speeded rather than retarded. It means that Japan submitted these things to the scrutiny of trained men who will return to their homes and tell what they think of Japan as one of the great industrial powers among civilized nations. That is probably the main cause and result of the meeting regardless of what developed in the technical sessions and in the other features of the congress.

The conference opened with a general meeting on Tuesday, Oct. 29, which taxed the large municipal auditorium to its capacity. Prince Chichibu, as patron of the congress, and Prime Minister O. Hamaguchi, as honorary vice-president, gave the opening addresses, after which the preliminary formalities were concluded under Baron K. Furuichi, the president, who is largely responsible for excellent arrangements which have been made. From then on to the closing ceremony on Nov. 7, the sessions were divided into the various groups, meeting at the House of Parliament for the discussion of papers.

AMONG the more strictly technical papers presented were: "Gelatination of Latex and Revertex," by P. P. von Weimarn, of the Imperial Industrial Research Institute, Osaka, Japan; "Antimony and Arsenic," by S. J. F. Jensen; and the "State of Solution of Cellulose Derivatives," by R. O. Herzog and B. Lange, of the Kaiser-Wilhelm Institute, Berlin. A general discussion of the electro-chemical industries of Sweden was given by Dr. W. Palmaer, professor of the Royal Institute of Technology, Stockholm. Gôsta Ekstrom, also of Stockholm, spoke on sulphite alcohol and its use. America was represented by, among others, "Development of Air-Nitrogen Industry," Harry A. Curtis; "Light Alloys," Zay Jefferies: "Petroleum," Mark L. Requa; "American Coal Industry," George Otis Smith; and "Non-Ferrous Metals," Frank Probert.

Fitted into the intricate program was a series of trips and inspection tours to take all of which would have kept one constantly on the move for a matter of months. Delegates selected according to their interest and saw the main engineering and industrial works of Japan within their given fields. Short trips of a few hours' duration were scheduled during the regular sessions in order to show the construction, manufacturing, and research work which is in progress near Tokyo and Yokohama. These show in particular the nature and scope of the post-earthquake reconstruction and the methods of insuring against the repetition of such damage as followed the disaster of 1923.

A third meeting, that of the Pacific Relations Conference, which is becoming a major factor in Oriental affairs, was held in Kyoto, Japan, simultaneously with the engineering sessions. Prominent statesmen, economists, and business men from all the major countries bordering on or having interests in the Pacific held their third biennial meeting to discuss on common ground some of the major problems in the East today. Although the Russo-Chinese problem loomed largest in the popular imagination, a study of long-time factors was more important. Among these are: population and races, communication, migrations, loans to Oriental nations, development of the mineral resources of Asia, and many others of interest to the world at large.

Pacific Coast Section of T.A.P.P.I. Meets

MEMBERS of the Pacific Coast section of the Technical Association of the Pulp and Paper Industry laid aside their work for the day on Oct. 5 and held an enthusiastic meeting on the Roof Garden of the Winthrop Hotel at Tacoma, Wash. About 80 attended the meeting.

The program was well organized and some interesting papers were read. The national association was represented by the president, P. H. Glatfelter, who talked on the development, value and function of T.A.P.P.I. Canada was well represented and Prof. W. F. Seyer, of the University of British Columbia, described the work of the Pulp and Paper Research Institute of Canada.

Dr. Wilhelm Hirschkind, of the Great Western Electro-Chemical Company, described the chlorine method of pulp production in an interesting paper.

C. M. Baker, of the American Pulp & Paper Association, Madison, Wis., in a plea for greater utilization of pulp and paper mill wastes, showed the inconsistency of an industry which, although established in part to utilize waste materials of the lumbering industry, does not utilize its own wastes to the fullest extent.

Arthur B. Green, of Portland, Ore., described a new instrument for controlling the beating of pulp. The action instrument depends on the torque required to maintain a finned rotor at constant speed and submerged to a constant depth in the pulp.

New officers elected are: Robert S. Wertheimer, of Longview, Wash., president; Ralph Reid, of St. Helens, Ore., vice-president; and Dr. H. K. Benson, of Seattle, Wash., secretary.

Advisory Committee For C. W. S.

MEMBERSHIP of the advisory committee to the Chemical Warfare Service, recommended by Maj. Gen. H. L. Gilchrist and approved by the Secretary of War, has been announced. The committee consists of Dr. W. D. Bancroft, chemistry department of Cornell; Dr. Bradley Dewey, of Dewey & Almy Chemical Company, Cambridge, Mass.; Dr. F. M. Dorsey, president of the Metal Protection Company, East Cleveland, Ohio; Dr. H. E. Howe, editor of the *Journal of Industrial and Engineering Chemistry*; Dr. Reid Hunt, of the department of pharmacology, Harvard Medical School; Dr. L. C. Jones, New York City; Dr. E. P. Kohler, chemistry department of Harvard, and Dr. A. B. Lamb, of the same department; Dr. W. K. Lewis, department of chemical engineering, Massachusetts Institute of Technology; Dr. C. L. Reese, E. I. duPont de Nemours & Company; Dr. Julius Steiglitz, chemistry department of the University of Chicago; Dr. G. A. Richter, of the Brown Company, Berlin, N. H.; Dr. L. T. Sutherland, of Zinsser & Company, Hastings-on-Hudson; and Dr. W. H. Walker, consulting chemical engineer, Bridgeton, Me.

Color Council Formed in Great Britain

The British Color Council was established on Oct. 9 as a result of a meeting which was supported by leading representatives of the textile trades, of the dyeing interest, and of other interested industries, such as leather and show manufacturing firms. The proper classification of colors and the establishment of names for colors in use so as to avoid a great variety of names for the same color was suggested as a reform which could be brought about by the British Color Council. It was also suggested that an international color conference, as a preliminary to the adoption of an international color card, would greatly facilitate the standardization.

NEWS FROM WASHINGTON

By Paul Wooton
Washington Correspondent of Chem. & Met.

A CHEMICAL conference is to be held in London, July 28 to Aug. 2, 1930, under the auspices of the Bureau of Foreign and Domestic Commerce and will be attended by its representatives in fourteen European countries. A number of officials of the Bureau will be in attendance, as will several members of the department's Chemical Advisory Committee. There will be sessions with representatives of interested trade associations.

The success of the conference in Paris this year, where conditions in only seven European countries were analyzed, led to the more ambitious plan for the 1930 meeting.

Dr. Julius Klein, the Assistant Secretary of Commerce, will be in attendance, as will C. C. Concannon, head of the Bureau's Chemical Division, and his assistant T. W. Delahanty. Other officials of the department who will be present are: Grosvenor M. Jones, of the Finance Division; Eric T. King, of the Specialities Division; Thomas R. Taylor, Assistant Director of the Bureau, and Louis Domeratzky, of the Bureau of Regional Information.

A. Cressey Morrison, chairman of the Advisory Committee to the Secretary of Commerce on chemical matters, will attend the conference, as will several members of his committee which, at present, is constituted as follows: A. Cressey Morrison, chairman; Harrison E. Howe, L. H. Baekeland, S. A. Blair, Alfred S. Burdick, Lammot Dupont, Henry Howard, Charles L. Huisking, Gustavus Ober, H. C. Parmelee, Fred Rosengarten, J. T. Skelly, Walter C. Teagle, Ernest T. Trigg and S. W. Wilder.

THE report of the Committee on Definitions of Terms and Interpretation of Results on Fertilizers was one of the features of the meeting in Washington Oct. 28, 29 and 30, of the Association of Official Agricultural Chemists. An additional referee was assigned to the higher analysis of commercial fertilizers. Other subjects which will receive special study by additional referees are: carbohydrates in plants and forms of nitrogen in plants. Officers for the ensuing year were elected as follows: Dr. H. W. Wiley, re-elected honorary president; E. M. Bailey, Agricultural Experiment Station, New Haven, Conn., president; H. D. Haskins, Agricultural Experiment Station, Amherst, Mass., vice-president; W. W. Skinner, Bureau of Chemistry and Soils, secretary-treasurer. The foregoing officers with the following constitute the executive committee: F. C. Blanch, Bureau of Chemistry and Soils; Dr. J. W. Kellogg, Department of Agriculture, Harrisburg; Dr. A. E. Paul, Food, Drug and Insecticide Administration, Chicago; Dr. H. B. McDonald, University of Maryland, College Park, Md.

The sulphate of ammonia war in Java has made that market perhaps the cheapest in the world. Synthetic sulphate of ammonia has been quoted as low as $5 per 100 kilos (220 lb.) f.o.b. Batavia. The big drop in price has been caused by the entrance of the Dutch sulphate of ammonia during the last two years. In 1926 only 4,000 tons out of a total importation of 108,000 tons was brought in from Holland; the first six months of 1929 showed an increase to 30,000 tons in a total of approximately 82,500 tons. American exports to Java amounted to 34,000 tons in 1926, and 20,500 tons during the first half of 1929.

JAPANESE competition is anticipated for next year, when their large factory, now being built, goes into operation. At present the market in Java is supplied principally by Holland, Great Britain, Germany and the United States. The Dutch sulphate of ammonia is produced by the Staatsmijnn, the state-owned mining industry, and by B.P.M. (Shell).

A definite move on the part of the British chemical interest to recapture the trade in ammonium sulphate is seen in the purchase of the firm of N. V. Handel & Industrie Mij. "Mestfabriek Java" by Imperial Chemicals, Ltd. "Mestfabriek Java" and the International Crediet & Handelsvereeniging "Rotterdam," agent for an American company, have been getting the largest part of the estate business in ammonium sulphate in the Netherland East Indies.

During the year 1928 Java purchased ammonium sulphate to the amount of $7,200,000, of which 40,627 metric tons was bought from the United States.

RETURNING to the chemical schedule of the tariff bill, after having passed from it to the earthenware and metals schedules, the Senate on Nov. 12 rejected the proposal of its finance committee that the rate on putty be increased from 0.75c. to 1c. a pound. The raise was proposed as compensatory for prospective higher duty on linseed oil, an important ingredient of putty. It was contended by Senator Barkley of Kentucky that, even if the duty on it is raised, the linseed oil factor isn't sufficient to justify the proposed raising of the putty duty.

An effort was made to have the Senate adopt the finance committee amendment putting the assessment of duties on synthetic indigo under the American selling prices rule applying to other coal-tar products. It was agreed that this should be done in case the rule is retained, but it was declared that the rule's retention will be contested.

The question of valuation bases of assessing duties on coal-tar products is the major feature of the chemical schedule yet to be determined. This will be taken up when amendments from the floor are in order, as the Senate Finance Committee offered no amendments to the paragraphs which provide that American selling prices be the bases of assessing those duties. Committee amendments to all schedules may be disposed of before individual or floor amendments are taken up. In that case the chemical schedule is not likely to be dealt with again until during the regular session of Congress. It is expected that when floor offerings concerning it are in order, amendments envisaging wiping out many House increases untouched by the Senate Finance Committee and scaling some duties not disturbed by either the House or the Senate committee will be offered by Democrats and Republican insurgents.

EXPORTS of American household insecticides during the first eight months of 1929 totaled $2,536,000. Germany was the principal consumer, taking over one-tenth of the total, while the United Kingdom, Canada and Cuba each took more than $150,000 worth of these preparations. Although the shipments were 13 per cent lower than for the corresponding period of 1928, the loss was entirely attributable to the falling on in shipments to Argentina, which market was overstocked in 1928.

A startling increase in imports was shown by Rumania, which jumped its imports value from $3,000 for the first eight months of 1928 to $105,000 for the same period of 1929. Of this sum $97,000 was spent on liquid sprays.

The Prussian State, now controlling 40 per cent of the "Gaveg" operating two Mont-Cenis synthetic ammonia plants at Sodingen, Westphalia, and at coal fields of the State-controlled Hibernia company, is expected to get majority control of this nitrogen enterprise. Despite threatened over-saturation of the German nitrogen market, these two Mont-Cenis plants have a reported capacity of 50,000 metric tons of primary nitrogen annually while another plant is in prospect at pits of the associated Recklinghausen company of another 40,000 tons nitrogen capacity. This would put 90,000 tons of fixed nitrogen, made by the Mont-Cenis ammonia synthesis, under control of the State.

Together with two other enterprises, Ruhrchemie A.G. and the Kali-Kloeckner Company with a combined fixed nitrogen capacity of approximately 40,000 tons, Ruhr synthetic enterprises may be envisaged as planning an annual production of 130,000 tons nitrogen immediately.

This calculation excludes the proposed fixed nitrogen plant of the Gewerkschaft Ewald, whose building is reported as progressing and which adds another nitrogen output of 20,000 tons annually. This plant is expected to be ready for operation about June 1930. It will use an American ammonia synthesis process.

Decline in Nitrogen Prices Affects British Chemical Companies

Values of Chemical Stocks Lowered by Less Favorable Outlook

From our London Correspondent

THE CHEMICAL industry of Great Britain will probably not suffer so soon or to the same extent from the present financial stringency and generally unfavorable situation, as other basic industries. Share values have been affected, of course, and in particular the prospects of Imperial Chemical Industries are no longer regarded so optimistically. This is partly due to the fall in nitrogen prices, and the absence of definite news in regard to results from the Billingham factory and other outlets for the recent increase in capital. In declaring an interim dividend at the same rate as in the previous year, brief mention was made of the present position, and the opinion expressed that Lord Melchett's forecast at the previous annual meeting would be fulfilled.

One adverse factor in the nitrogen position, and particularly as affecting I.C.I., is the new nitrogen development of the Consolidated Mining & Smelting Company, at Traill, in British Columbia, the fertilizer there produced being a serious factor in regard to export to the Far East, and if the production ultimately aimed at at Traill should be realized, it will be a serious factor even in the world's nitrogen production. In Europe, the nitrogen position continues to be of interest, inasmuch as there is a distinct movement toward an understanding between the I.G. and the other German nitrogen producers, whose presence has no doubt made itself felt, and is said even to have led to overproduction at Oppau and Merseburg.

THE BELGIANS are producing at very low cost, but with a limited output, and have not felt the necessity of joining in any of the national understandings. It would seem, therefore, that the increase in the world's nitrogen production will be filled mainly by existing plants, and that new installations will be mostly based upon hydrogen from coke-oven gas. In this connection, attention is drawn to a paper just contributed to the Institute of Fuel by Edgar Evans, head of the fuel department of the National Federation of Iron and Steel Manufacturers. Mr. Evans gives a very complete survey of the economics of coke-oven gas utilization in industry, and makes interesting comparisons between the conditions prevailing in America and in this country.

It is said that the iron and steel industry may soon become a consumer on a large scale of coke-oven gas, seeing that it can afford to pay between 12c. and 20c. per 1,000 cu.ft., less the cost of distribution. The price at the coke ovens would be reduced by the cost of distribution, which may amount to 2c. per 1,000 cu.ft., and it seems doubtful whether a gas network scheme such as has been developed in Germany would be of advantage in any producing area except on a relatively small scale, and within limited radius. Mr. Evans pointed out that the utilization of coke-oven gas will be a determining factor in the modernization of coking plants in this country, and points out that synthetic ammonia is one of the more promising methods of selling gas, inasmuch as the hydrogen content is worth at least 12c. per 1,000 cu.ft. and the residual gas is of higher calorific value.

It might be added that coke-oven gas appears to be in the same sort of position as coal tar was two or three generations ago and that perhaps we are on the threshold of a similar rational development in its constituents, the waste products of today being the valuable products of the future. The methane, propylene, ethylene and acetylene which are obtained by fractional liquefaction of coke-oven gas are attaining increasing importance, not only as raw material for chemical manufactures but as concentrated fuel for transportation over limited distances and for special services such as motor and airship transport. Truly it may be said that the burning of these valuable constituents appears illogical and uneconomic.

THE coal industry is again in a state of grave uncertainty because of the wages and hours question, and there seems no escape at the best from a gradual reduction in working hours without reduction in daily wage rate. In this connection the *Industrial Chemist* gives a fully illustrated account of the new coal cleaning plant installed by Amalgamated Anthracite Collieries, Ltd., and working on the Lessing system, which uses calcium chloride solution. This method has previously been referred to in these notes and the first plant appears likely to be the forerunner of many others, because of its successful and economic operation.

The anthracite is first de-dusted by air separation and the dust is taken to pulverized-fuel boilers in tanks which are similar in design to those which have been used for the last twenty years for powdered lignite in Germany. The calcium chloride washers reduce the ash content of the coal to about 2 per cent, and because of the de-dusting it is possible to drain the finished material to about 5 per cent of moisture. The loss of calcium chloride is less than one-half gallon per ton and about 100 gallons of fresh water per ton treated are required, but most of this can be re-used. About 70 gallons of weak calcium chloride liquor has to be reconcentrated per ton of coal. The total cost of operation is said to be 11c. per ton of raw coal.

The British patent system is again on trial and a governmental commission of qualified experts is taking evidence with a view to making suitable recommendations to the legislature. The British Science Guild issued a report some months ago on the working of the British patent law and the latest champion of revision is Dr. Herbert Levinstein, the new president of the Society of Chemical Industry. In an address which he recently delivered at Bristol, Dr. Levinstein protested against the cost of patent litigation and the risk of having to face this in order to decide the validity of a British patent. He complained that the British search was wholly insufficient. He cited numerous cases from his own experience of legal intimidation by powerful firms and also referred to the enormous number of patents which are increasingly being applied for by the I. G. and the general increase in "blocking" patents.

DURING recent years white portland cement has been imported from the United States and the introduction on the part of the Associated Portland Cement Manufacturers in this country of their own white cement under the trade mark "Snowcrete" is therefore of interest. This is a true portland cement, which owes its whiteness to the fact that it is almost free from oxide of iron, and of course it is necessary to use clean and relatively pure raw materials. "Snowcrete" has met with a good reception and is definitely lower in price than the American product previously imported.

The plant put down at Richmond by the Gas Light & Coke Company and designed by the Fuel Research Board is beginning operations and the usual difficulty in starting up a plant of this character was encountered. Naturally the capital cost was higher than would be the case in a large commercial plant, but the semi-coke finds a ready market and valuable information and experience will be gained. The fly in the ointment will be the difficulty in disposing of the low-temperature tars in view of the increasing production, and similarly the expanding market so created for the slack and the replacement of ordinary household coal by semi-coke may force collieries to increase the price for slack in order to restore the balance.

The experiments on hydrogenation and purification of coal are encouraging and a beginning has been made with the chemical examination of pitch in relation to its use for briquetting.

Alum Deposits Near Victoria

Reports from Victoria, B. C., state that a group of Canadian business men have organized a company to carry on extensive development work for the recovery of ochre and alum deposits near Victoria. There is a growing market for both products in the province which makes this development more important.

France Increases Consumption of Sulphuric Acid

Larger Production of Rayon and Superphosphates Stimulates Demand for Acid

From our Paris Correspondent

ONE OF the best means of judging a country's chemical industry is to consider its home production and consumption of sulphuric acid. It is therefore clear that the French chemical industry is steadily increasing, as the price of chamber acid, 53 deg. Bé., is rising continuously owing to growing demands.

France's largest chemical manufacturer, the St. Gobain Company, which already has 27 chemical works, is now erecting another at La Bassée, near the old front line. The new works will not be ready for use for some time, as it includes six batteries 80 yd. long and 40 yd. wide. The St. Gobain Company contemplates the production of artificial wool according to the viscose Pellerin process, which utilizes sulphuric acid as a coagulating agent in the spinning bath. On the other hand, as the rayon output increases—another viscose rayon factory has been built at Odornez near Valenciennes, (Nord) by the Textiles Chimiques du Nord ou de l'Est—the consumption of sulphuric acid also rises in that branch of the chemical trade.

The largest consumer of chamber acid is the superphosphate industry, which absorbs about three-quarters of the home output. In 1928 the French superphosphate output reached 2,350,000 tons and in addition 708,000 tons of basic slag. The respective phosphoric anhydride contents of superphosphate and basic slag, that is their active substance, being 295,500 tons for the former and 127,300 tons for the latter, more than 2,000,000 tons of inactive products have thus been transported and handled. This clearly shows that concentrated superphosphates are highly preferable, especially in overseas trade. One of the first concentrated superphosphates factories built in France has been erected by the Société des Phosphates Tunisiens. Its Pierrefitte Nastelas works has four electrical ovens of 5,000 kw. each using the process of the Federal Phosphorus Company, of Birmingham, Ala. Acid phosphoric is thus produced, part of which is transformed into ammonia phosphate, ammonia being made by the same firm in its Soulon Works. These works produce 57,000 q.m. of ammonia almost all of which is turned into nitrate of calcium containing 13 per cent of nitrogen.

ALTHOUGH French farmers are large consumers of phosphoric fertilizers (470,000 tons of phosphoric acid yearly) they use only 140,000 tons of nitrogen and 180,000 tons of potash. Therefore a wide margin for the full development of potash and nitrogen still exists. In order to advertise the use of the latter the French State Railways ran from Aug. 24 to Sept. 16 a propaganda train exhibiting fertilizers and selected seeds. The results were highly favorable.

We have already referred to the steady increase of the production of synthetic ammonia, especially in the mining districts. The total capacity is estimated to be about 130,000 tons, but this output has not been reached yet and will not be for some time.

Though the general tendency is to produce synthetic ammonia first and afterward turn it into nitric acid by oxidation, nitric acid is obtained also by the electric arc process. This process is used successfully in France by the Société Le Nitrogéne. Another advantage of this firm's process over the one used by its competitors is its economy of capital and labor.

FOUNDED in 1889, the Ugine Electrometallurgical and Electrochemical Steel Works have just celebrated their fortieth anniversary. Since 1889 this firm has applied its electrolytical processes in the manufacture of chlorate in its Vallorbe works. It also produces perborate of sodium in its Pierre-Bénite works, also recently electrolytically oxygenated water of 30 per cent concentration. This firm also manufactures metals and alloys. It has built a new factory at Annecy for the treatment of tin ores by a new patent process and the manufacture of tungsten as a byproduct. According to the latest reports, the results obtained with this new process are most satisfactory. The development of this industry, however, will be hampered by the high price of tin ores in France, as most of it must be imported, the home tin mines yielding only small quantities.

At its last general meeting the board of the Société Le Ketol gave its shareholders an optimistic view of the near future. As the costly experimental period has passed, it is hoped satisfactory financial results will be obtained. This firm uses sawdust as raw material saccharified by acid, the sugar obtained being transformed by an appropriate fermentation process into butyric acid which, neutralized by lime, gives butyrate of calcium. By dry distillation this product yields ketol, a mixture of cetones. An adequate dry distillation was very hard to obtain and it is only quite recently that all difficulties were overcome and a suitable continuous oven could be built. The present calcium butyrate output is about 6 tons daily, half of which is distilled, yielding 1 ton of ketol whose commercial outlet is the cellulose lacquer and varnish industry which uses it as a solvent.

Corrosion Problem Studied By Paper Industry

A SEVERE corrosion situation confronts the sulphite pulp industry. In the solution of the problem, the Corrosion Committee of the Technical Association of the Pulp and Paper Industry is prepared to assist the manufacturers in obtaining data on the resistance of materials submitted for test. The committee invites the producers of corrosion-resistant alloys to submit samples of their materials for tests.

Three experimental stations have been established which are equipped to conduct the tests. Owing to the nature of sulphur dioxide solutions, laboratory tests are inadequate, consequently the committee has standardized on a test which closely approximates service conditions. The samples are exposed to the most severe conditions existing in the industry, and a matter of 500 digester hours are sufficient to rate the most resistant metals.

The specimens are 2x1x$\frac{1}{8}$ in. with two $\frac{3}{16}$-in. holes drilled $1\frac{1}{2}$ in. from center to center. The spacing of the holes is the the only exact dimension required. Pieces are carefully cleaned, measured and weighed before and after the test.

Exposure takes place in the corrosive chamber, which consists of a piece of 3-in. pipe 10 in. long, or the equivalent, flanged at both ends. To avoid electrolytic action, the samples are supported on glass rods, which are in turn supported in the chamber by two metal plates, drilled to receive the rods. Samples are spaced and kept in position by glass beads. These metal plates extend through the chamber, parallel to each other and to the axis of the chamber.

When all of the samples are assembled, the chamber is hooked into a bypass in the digester relief line, where the samples are exposed to the action of 100 per cent sulphur dioxide, saturated with the water vapor and moving at considerable velocity. The pressure is about 40 lb. and the maximum temperature 150 deg. C. These conditions are inconvenient to duplicate in the laboratory. The test is an improvement over the usual method of suspending specimens from the strainers.

The three stations may not duplicate results numerically, because of different cooking conditions and methods of handling the digesters, but they will rate metals in the same order of resistance. The method is not particularly novel, but has been found to be entirely satisfactory in the examination of twenty specimens to date.

It is requested that interested persons send three samples of each alloy to be tested to J. D. Miller, chairman of the Corrosion Committee. If duplicates are desired, increase the number accordingly. The analysis of the samples should accompany each shipment.

Fuels Hold Prominent Interest of German Chemical Industry

Lignite, Coke, Tar-Coking, and Cracking Make Demands on Engineering Research

From our Berlin Correspondent

THE INSTITUTE OF METALS held its general meeting this year at Düsseldorf on invitation of the German Metallkunde Society and the V.D.I. Among the many important papers read there, M. Tama, engineer, of Eberswalde, spoke of the development of new induction furnaces for non-ferrous metals, having a large capacity and applicability for high-melting alloys such as nickel, copper, and phospor-bronze. Although Europe in general lags behind America in the use of electric furnaces, the units employed in the former are larger and it has been found that the current consumed for 120-kw. furnaces is 10 per cent less per ton of metal than in 80-kw. furnaces.

Dr. Zeerleder and P. Bourgeois, in speaking of open-air cables, found that the temperature generated in copper is greater than in aluminum and its alloys. especially "Aldrey," which contains aluminum with 0.4 per cent magnesium, 0.5-0.6 of silicon and not more than 0.3 of iron. The latter is already finding extensive use in electric cables, and is not influenced by temperatures that harm the mechanical properties of copper; aluminum alloys, in addition, may even carry higher voltages than copper.

In a corrosion meeting held at Vienna, jointly by German and Austrian societies, Professor Maas, of Berlin, made the danger of rust emphatic by showing that from 1860 to 1920, 40 per cent of the world's iron production was lost as rust, while in Germany the annual corrosion loss is judged at 1-1½ billions of marks.

THE FOREST PRODUCTS industry will be interested to hear that improvements have been made in the conversion of beechwood to cellulose. The main hindrance had been the unfavorable short fiber produced from beech, but Dr. H. Kumpfmiller, director of the Münden Zellulosenfabrik, was successful in modifying the Mitscherlich-Ritter-Kellner process in such a way as to produce a desirable pulp. For the manufacture of stationery and fine printing paper, a mixture of beech and spruce was found best, and in certain types the beech content is as high as 60 per cent.

A new film-evaporation apparatus has been constructed by Dr. Zahn, of Berlin, which allows continuous and rapid distillation of organic compounds without dissociation. He employs a funnel-shaped heating surface, at the edge of which the fluid is uniformly introduced and allowed to run down. Evaporation begins immediately, and foaming, entrainment, and spattering is not possible. Up to eight funnels are superimposed, the liquid collecting at the centers is caught by a distributing plate, and centrifugal distribution of the liquid then takes place to the upper edge of the funnel beneath. The uppermost funnel is heated by steam to 60 deg. C., while the liquid on the lowest is heated to 180 deg. In many cases a water removal of 80-90 kg. each hour per square inch of heating surface is obtained, without the use of vacuum. The apparatus is applicable to all sorts of mixtures, such as organic and the various petroleum and coal products.

THE LIGNITE INDUSTRY, of ever-growing importance, predicts a production increase of 6 per cent over 1928 and a coke increase of 13 per cent. In spite of the strife facing this group within and without, development was made possible by thorough rationalization and technical improvement. Three factors are especially concerned: first, the combination of chemical industry with power plants; second, direct conversion of coal to automotive fuels; and third, gas production for city and industrial use. To speak only of gas, its yield is as great, on a dry basis, from lignite as from hard coal; from the former, however, it is obtained about twice as rapidly in the same equipment. Lignite's promise is thus linked with a power industry representing already thirty billion kilowatts, and up to now its mining has been entirely on the surface with deeper deposits recently discovered.

A new method, striking for its simplicity, for the dry cooling of coke is reported by the Kohlenscheidungsgesellschaft, Berlin, which mixes glowing coke in furnaces or ovens with coal. A mixture of complete and semi-coke is obtained which can be used both as domestic fuel and in a generator, where the residual heat is still advantageous for gas making.

Tar coking, which recently came to notice, is described by J. P. Koettnitz as follows: The greatest importance is placed on obtaining pure coke, qualified for making electrodes. For this reason it is necessary that it has all been exposed to at least 1,000 deg. C., a condition that is successfully met by the recent progress in making metallic and refractory equipment. In order to obtain the coke in a reasonable time, the layer may not exceed 50 cm. in thickness. The products of a tar softening at 60-75 deg. are: coke, 58 per cent; distillate, 36 per cent; gas and loss, 6 per cent. The distillate is mixed with coal oil freed of anthracene, and the latter residue is exploited for its anthracene. The largest competition of tar coke, of course, is petroleum coke, and its consuming fields are the aluminum, electrode, cyanamid, carbide and foundry industries.

A German cracking process, developed by H. Wolf under the name of the Carburol process, is designed to effect cracking without coke formation and achieves this by heating the raw material constantly in a coil under pressure at cracking temperature and then releasing it by a specially constructed valve. On release it is immediately mixed with cool distillate or fresh oil, is thus cooled, and is interrupted in its cracking. Of utmost importance is the control of the time after which the chilling occurs. A further advantage of the process is that the products (raw gasoline, oil, gas) can be adjusted to suit the demand. A 0.878 gas-oil once gave 77.7 per cent by volume of gasoline (0.749), 20.9 of heavy oil, and 1.9 of gas; another time it yielded 61.4 per cent gasoline (0.745), 34 of heavy oil (0.974), and 4.6 of gas. The equipment for the process is built by A. Borsig, G.m.b.H., Berlin-Tegel, and smaller units producing 30, 50 and 100 tons daily have likewise been operated very economically.

Conference on Lime Held At New Haven

UPON call of Charles J. Brand, a meeting of lime and fertilizer manufacturers and agronomists was held Nov. 1 at New Haven, Conn., to find ways and means for increasing the use of lime on New England farms. The net result of the meeting was the formation of a joint committee of 10 members, on which are representatives of the lime and fertilizer manufacturers, the New England agronomists, the National Lime Association and the National Fertilizer Association.

It was the consensus of those present that New England farmers are at present using far too little lime on their farms and that an increase in lime consumption will mean larger returns to the farmer, a better business for the New England lime producers, and more satisfactory results with commercial fertilizer.

The joint committee appointed is made up as follows: Representing the lime industry: W. E. Healey, Boston, Mass.; Fred A. Daboll, West Stockbridge, Mass.; J. M. Deeley, Lee, Mass.; Carroll D. Ryder, Danbury, Conn. Representing the fertilizer industry: M. S. Hazen, Boston, Mass.; F. H. Whipple, Hartford, Conn.; Evan H. Jones, Waterbury, Conn.; J. B. Abbott, Bellows Falls, Vt. Representing the extension services: J. S. Owens, Storrs, Conn.; E. Van Alstine, Burlington, Vt.

This committee organized with M. S. Hazen as chairman and J. B. Abbott as secretary. The first meeting will be held at Springfield, Mass., on Nov. 25, at which time plans will be made for carrying on an aggressive campaign to promote the use of lime on New England farms.

MEN in Chemical Engineering

FREDERICK W. WILLARD has been promoted to assistant works manager of the Western Electric Company's Kearny Works to succeed F. A. Macnutt, who was made works manager at Point Breeze, Md. Mr. Willard has been with the company since 1906, where he went soon after graduating from the University of Michigan. His rise had been steady and took him from Chicago to Philadelphia, where, in 1928, he became personnel director.

GEORGE O. CURME, JR., H. E. THOMPSON and R. W. WHITE have been named as vice-presidents of the Carbide and Carbon Chemicals Corporation. They will continue in charge of research, engineering, and sales activities.

PER K. FROHLICH, who was assistant director of the research laboratory of applied chemistry, Massachusetts Institute of Technology, has joined the Standard Oil Development Company, Elizabeth, N. J.

C. OLIN NORTH has resigned as chemist and rubber technologist of the Rubber Service Laboratories Company and the Elko Chemical Company. As one of the original incorporators and leaders of the former company, he was made a vice-president when it was recently absorbed by Monsanto Chemical Works.

JOHN ARTHUR WILSON has resigned as chief chemist of A. G. Gallun & Sons Corporation to become president of John Arthur Wilson, Inc., Milwaukee, which will deal with leather, sewage disposal, and industrial problems.

ROBERT E. HUMPHREYS, vice-president of the Standard Oil Company of Indiana, has been placed in general charge of the manufacturing of the company and its affiliated interests.

GENTRY CASH has been appointed as general manager of manufacturing for the Standard Oil Company of Indiana and its subsidiaries.

GEORGE W. SCHULTZ, authority on leather chemistry and chief chemist of the American Oak Leather Company, has left this position to take up new duties as manager of the Shanghai Leather Company. He proceeded on his way to Shanghai on Nov. 12.

DONALD B. KEYES, professor of chemical engineering at Illinois University, and Mrs. Keyes were very interested spectators at some extemporaneous amusement while guests of Henry H. Harris at Champaign, Ill., on Nov. 9. A group of bandits surprised the dinner party, numbering over 100, and, after unburdening them of valuables cooperated with the freshly arrived constabulary in providing an intensive display of fireworks.

H. C. PARMELEE, editorial director of the McGraw-Hill Publishing Company and past editor of *Chem. & Met.*, led a party of McGraw-Hill editors, including JAMES A. LEE, of *Chem. & Met.*, on a comprehensive tour of New England covering 40 cities and some 75 plants. The trip lasted two weeks and provided a cross-sectional view of New England industry.

G. R. STURTEVANT, who was rubber chemist for the Western Electric Company at Hawthorne, Ill., has joined the U. S. Rubber Company's research laboratories at Passaic, N. J.

W. L. BADGER, professor of chemical engineering, is on leave of absence from the University of Michigan until next February. His headquarters remain at Ann Arbor, and while active as president of the new Whiting-Swenson Company, he will continue his university work.

RALPH A. POWERS and LOUIS H. CARTER have been elected, respectively, executive vice-president and vice-president in charge of manufacture of the American Agricultural Chemical Company.

OBITUARY

F. A. J. FITZGERALD

FRANCIS ALEXANDER JAMES FITZGERALD, consulting engineer identified with the rise of the electrochemical industry, died at his home in Niagara Falls, N. Y., on Oct. 27 after a sudden attack of pneumonia. As a native of Ireland, Mr. Fitzgerald was graduated from Trinity College, Dublin, and came to this country in 1893 to attend the Massachusetts Institute of Technology. His graduation there was followed by eight years' association with E. G. Acheson in both the Carborundum Company and the Acheson Graphite Company. In 1903 he launched on a consulting career in Niagara Falls, in which he was active until the time of his death.

R. W. BALCOM, who was in charge of food and drug enforcement work of the Government, died suddenly as a result of cerebral hemorrhage on October 17. Dr. Balcom, a native of Nova Scotia, was born in 1877.

EDWIN ALLSTON HILL, professor-emeritus of chemistry at George Washington University and a faculty member there for 20 years, died on Oct. 28 in Washington, D. C., at the age of 78.

Blank & Stoller

EDWIN E. SLOSSON

EDWIN EMERY SLOSSON died at his home in Washington, D. C., on Oct. 15 after a protracted heart ailment. A native of Kansas, Dr. Slosson was born in 1865 and launched on his literary career after an education and professorship in chemistry which lasted until 1903. At that time he became an editor of *The Independent* and held this post until 1920, when he was called to serve as editorial director of Science Service.

Dr. Slosson's pen made its heaviest inroads on the mystery that once clouded every concept of chemistry. With his name, of late years, appearing as a surprisingly prolific supporter of numerous educational institutions and publications, we get a notion of the breadth quietly gained by his personal crusade, as originally launched in "Creative Chemistry."

OTTO MATTHIES, prominent dye chemist of Wolfen, Germany, died as the result of a fall from his room in the Savoy-Plaza Hotel in New York on Oct. 25. He had been in the country only a few days, having come as a representative of the German I. G. Farbenindustrie to visit the American I. G. plant at Binghamton, N. Y.

CALENDAR

AMERICAN CHEMICAL SOCIETY, 79th meeting, Atlanta, Ga., April 7 to 11, 1930.

AMERICAN ELECTROCHEMICAL SOCIETY, spring meeting, St. Louis, May 29-31, 1930.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, winter meeting, Asheville, N. C., Dec. 2-4.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, annual meeting, New York, Feb. 19-21, 1930.

MARKET APPRAISAL OF CHEMICAL INDUSTRY

American Solvents & Chemical Corporation has declared initial quarterly dividend of 75c. on preferred stock.

Columbian Carbon Company has extended rights to subscribe to additional stock, in ratio of nine new shares at $175 a share to every 100 shares held, to March 11, 1930, from previously announced expiration date of Nov. 11.

Stockholders of Firestone Tire & Rubber Company have approved increase in authorized common stock from 2,500,000, $10 par shares to 3,500,000 shares $10 par. They also authorized creation of 1,000,000 shares of $100 par cumulative preferred stock, 600,000 shares of which will be offered publicly.

Dow Chemical Company declared a dividend of 50c. on common and regular quarterly dividend of $1.75 on preferred, both payable Nov. 15 to stock of record Nov. 1. This is the first dividend since a 400 per cent stock dividend was paid on the common on Oct. 15.

Sherwin-Williams Company has declared a quarterly dividend of $1 on the common and an extra dividend of 12½c. on the common, both payable Nov. 15 to stock of record Oct. 31. Quarterly dividend of $1 places stock on $4 annual basis against $3 previously.

Borax Consolidated, Ltd., of London, has passed interim dividend on its £1,150,000 of £1 deferred ordinary shares for first time in 31 years. Company has issued capital of £2,550,000 and £2,214,234 of bonds and debentures.

Glidden Company reports net sales of $34,240,457 in the first eleven months of the company's fiscal year, compared with $24,665,216 in the corresponding 1928 period, an increase of 38.8 per cent.

Directors of the Newport Company have authorized the issuance to common stockholders of rights to subscribe on or before Dec. 20 for additional common stock at $20 a share on the basis of one new share for each forty shares held on Nov. 23.

Net earnings of some of the technical and allied companies for the first nine months of the year are reported as follows:

	Jan.-Sept. 1929	Jan.-Sept. 1928
Air Reduction	$4,292,956	$2,528,166
Am. Com. Alcohol	805,867	....
Atlas Powder	2,049,056	1,604,339
Beechnut	2,427,139	2,303,441
Bon Ami	1,126,414	955,366
Com. Solvents	2,809,662	2,099,774
Corn Products	10,869,182	8,906,388
Du Pont	61,566,243	52,278,679
Evans-Wallower	374,880	280,873
Hercules Powder	3,236,190	2,820,112
Lambert Co	5,446,382	4,587,555
Mathieson Alkali	1,952,258	1,797,293
Nat'l Dist. Products	462,845	311,218
N. J. Zinc	6,945,625	5,444,928
Newport Co	1,173,952	622,313
Phillips Petroleum	15,029,588	12,366,133
Skelly Oil	4,813,450	2,462,407
Texas Gulf Sulphur	11,480,489	10,355,381
Union Carbide	31,379,874	26,617,549

Price Range Jan.-Oct. High	Price Range Jan.-Oct. Low	Stock	Price Range in October Oct. 1	High	Low	Oct. 31
223⅞	95½	Air Reduction	194⅞	221	100¼	142½
11½	2½	Ajax Rubber	3¼	3⅞	2½	2⅞
354⅞	204⅞	Allied Chemical	313½	322	204¾	251
125	120¼	Allied Chemical, pf	122¼	123	120½	121⅞
23⅞	4	Am. Ag. Chemical	8½	10	4	7⅞
73⅞	25½	Am. Ag. Chemical, pf	37½	41	25½	28⅞
69½	28⅞	American Cyanamid, B	52¼	58½	28⅞	32⅞
10	6	American Hide & Leather	....	8	5	....
81⅞	41½	American Metal	71	73	41½	49½
37	19½	Am. Solvents & Chemical	32	33½	19⅞	19½
45⅞	15	Anglo-Chile Nitrate	34	37¼	15	26
49⅞	22⅞	Archer-Daniels-Midland	39	45⅞	22¾	31⅞
27½	3⅞	Assoc. Dyeing & Printing	7	7½	3⅞	4½
140	80	Atlas Powder	128¾	137⅞	80	95½
32⅞	17	Beacon Oil	27½	29	17	20⅞
101	67	Beechnut Packing	84½	85½	67	75
89½	70	Bon Ami, A	83¼	84	70	79
31	25	California Petroleum	....	31	29⅞	29⅞
57½	20	Celanese	30	36	20	30
122	....	Celanese, pf	86	90	85½	....
32	13	Certainteed	27	27½	13	18
50	29	Chickasha Cotton Oil	35½	36	29	30
90	46½	Colgate-Palmolive-Peet	79¾	89⅞	46½	65⅞
63	20⅞	Commercial Solvents	....	63	20⅞	38
126⅞	82	Corn Products	112¼	121⅞	90	103½
69⅞	21¼	Davison Chemical	50	55	21¼	37
64¾	33	Devoe & Raynolds	44⅞	46½	33	38
....	....	Devoe & Raynolds, pf	....	113	....	....
231	80	Du Pont	190	231	80	140
119¾	111	Du Pont, 6 p.c. deb	115¾	195	111	113½
264⅞	162	Eastman Kodak	219¼	264¾	162	208½
309	170	Firestone Tire	230	295	170	210
20⅞	3½	Fisk Rubber	6¾	8⅞	3½	5⅞
54¾	24	Freeport Texas	44¼	45¾	24	35
64⅞	26	Glidden Co	53⅞	55½	26	39
106⅞	99	Glidden Co., pf	103	104½	99	100
82	31½	Gold Dust	66½	69⅞	31½	49
105¾	42	Goodrich Co	68⅞	71¾	42	56
130	90	Hercules Powder	....	....	90	90
109	26	Houston Oil	92¾	98¼	26	49⅞
135	75	Industrial Rayon	86	87½	79¼	89⅞
17⅞	4	Int. Ag. Chemical	7	7⅞	4	5⅞
88½	53	Int. Ag. Chemical, pf	....	63½	53	58
44¼	23	International Paper, A	34	37⅞	23	32
90	55½	International Salt	....	76	63	70
24	4	Kelly-Springfield	8	10¼	4	7
25	5	Lee Rubber & Tire	10⅞	11½	5	9⅞
43	17	Libby-Owens	37½	39¾	17	29
113⅞	40	Liquid Carbonic	83⅞	87	40	58
72⅞	29	Mathieson Alkali	64	71½	29	46⅞
80½	60	Monsanto Chemical	....	80½	60	72½
58	15	National Dist. Products	46¾	50⅞	15	35
210	132	National Lead	175	210	141	159
87⅞	69	New Jersey Zinc	.....	84½	69	76
79⅞	64½	Ohio Oil	77¾	79½	65	72⅞
89½	50	Owens Ill. Glass	....	87¾	50	60
47	27	Phillips Petroleum	37⅞	42½	27	34⅞
76½	59⅞	Pittsburgh Plate Glass	....	68¼	59⅞	....
85	55¼	Pratt & Lambert	69	72⅞	55¼	....
....	....	Procter & Gamble	....	....	....	....
30⅞	20⅞	Pure Oil	25⅞	28	20⅞	25
105⅞	....	Sherwin-Williams	....	91	....	....
48¼	23½	Silica-Gel	28½	36⅞	24	....
45	22½	Sinclair Oil	34¼	36¾	22½	29
46½	28	Skelly Oil	40	41⅞	28	32¼
81⅞	51½	Standard Oil, Cal	73¾	77½	51½	67⅞
83	48	Standard Oil, N. J	73⅞	81¾	50	70¼
48⅞	32	Standard Oil, N. Y	43	46	32	38¾
9⅞	2⅞	Standard Plate Glass	3⅞	3¾	2⅞	3
86⅞	57	Sun Oil	77	80½	62	69⅞
....	....	Swan & Finch	....	....	....	....
20⅞	10	Tennessee Copper & Chemical	17¼	18	10	14½
71⅞	50½	Texas Corporation	64¾	67⅞	50½	57⅞
85¼	45	Texas Gulf Sulphur	67⅞	71⅞	45	61⅞
....	....	Tidewater Oil	31	....	....	....
550	150	Tubize Silk	....	334½	150	....
140	66	Union Carbide	120½	128⅞	66	96
57	43½	Union Oil, Cal	53⅞	57	43½	47⅞
48⅞	20	United Piece Dye	....	39¾	20	28
243⅞	125½	U. S. Ind. Alcohol	208	243⅞	125½	151¼
35½	11	U. S. Leather	20⅞	21⅞	11	14⅞
65	15	U. S. Rubber	52¾	56½	15	36⅞
133⅞	75½	Vacuum Oil	121½	127½	75½	108
116½	48½	Vanadium Corp	83¼	86¾	48½	61
51⅞	33	Vick Chemical	45	46⅞	33	39½
24⅞	3½	Va.-Ca. Chemical	10⅞	10⅞	3½	7⅞
65½	15	Va.-Ca. Chemical, pf	35	37⅞	15	22¼
48	20	Wesson Oil	33	34	20	30
13½	4½	Wilson & Co	5⅞	5⅞	4½	5

ECONOMIC INFLUENCES *on production and consumption of* CHEMICALS

Production of Chemicals Gained in Volume Last Month

Consuming Industries Showed Tendency to Cut Down Requirements

GENERAL industrial activity last month, as indicated in the consumption of electrical energy by more than 3,600 manufacturing plants, was 3.9 per cent above October, 1928, but showed a drop of 0.8 per cent from the level established in September.

This is the conclusion drawn by *Electrical World* as the result of its monthly survey of consumption of electricity in manufacturing lines. Four of the primary manufacturing groups—chemical products, paper and pulp, rubber products and textiles—increased their rate of operations in October as compared with September. On the other hand, seven industrials—food products, rolling mills and steel plants, ferrous and non-ferrous metal-working plants, leather products, automobiles, including the manufacture of parts and accessories, and stone, clay and glass—reported a drop in activity during October as compared with the month preceding.

Plant operations in six industrial groups were higher during October than for the same month last year; four manufacturing groups reported a drop and one was the same. Sectional increases in the rate of manufacturing activity in October, this year, as compared with the like month last year, were as follows: New England, 5.8 per cent; Middle Atlantic States, 08 per cent, and Southern States, 1.2 per cent. The North Central States reported a 2 per cent drop and the Western States a 1.6 per cent drop.

REPORTS on the movement of raw materials to chemical manufacturers and trade opinions regarding productive operations likewise indicate that the output of chemicals last month was maintained on a high plane and exceeded that for the preceding month and for the corresponding period of last year. Hence, production of chemicals for the year to date has surpassed the total for the ten-month period of 1928.

Views expressed on the status of consuming industries, however, are not so favorable. In some quarters there has been a tendency to cut down inventories and this has affected both the demand for raw materials and the production of finished goods. Some slowing up was to be expected in view of the very active rate at which most lines of industry had been operating. A feeling of caution was injected into the situation by the sharp break in the securities market. While this in itself need not necessarily affect manufacturing it has, temporarily at least, created a feeling of uncertainty which reflects upon the general economic situation.

This is exemplified by the action taken last week by executives of more than 100 mills engaged in the manufacture of yarn. These executives met at Charlotte, N. C., and decided as individually acting members to curtail production substantially for the duration of the present emergency in the nation's financial affairs. At another meeting manufacturers of print cloths and other textile fabrics decided individually to curtail production for the best interests of the industry.

TOTAL sales of paint, varnish and lacquer products during September, as reported to the Department of Commerce by 388 firms, aggregated $29,-694,051, as compared with $34,428,941 in the preceding month, and $27,967,064 in September, 1928. This summary represents a revision of the data heretofore compiled and will be subject to further revisions in subsequent issues as reports are received from additional concerns. Detailed statistics are given below, by months:

Sales of Paint, Varnish, and Lacquer Products

	1929	1928
Jan.	$24,935,873	$23,211,240
Feb.	25,133,727	24,565,971
March	32,260,827	29,765,549
April	34,840,099	30,537,081
May	37,619,643	36,498,142
June	33,569,795	33,585,807
July	28,456,902	26,684,736
Aug.	34,428,941	30,901,278
Sept.	29,694,051	27,967,064
Total	$280,939,858	$263,716,868

Comparison of productive and consumptive activities in some branches of the chemical and chemical-consuming industries is offered in the following table, the figures being the latest available:

Production

	September 1929	September 1928
Automobiles		
Passenger cars, No.	364,786	358,615
Trucks, No.	49,681	56,423
Taxis, No.	865	276
Rosin, wood, bbl	36,905	35,473
Turpentine, wood, bbl	6,695	6,253
Pine oil, gal.	222,112	211,828
Glass containers, 1,000 gross	2,246	2,322
Plate glass, 1,000 sq.ft.	14,011	10,897
Oil refined, 1,000 bbl.	84,099	79,894
Explosives, ton	42,019	35,310
Consumption		
Cotton, bales	545,649	492,307
Silk, bales	53,274	47,797
Wool, 1,000 lb.	49,755	43,492
Cottonseed oil, bbl.	357,000	342,000

The Department of Commerce has just issued data on factory production and consumption of vegetable oils. As some of these oils are imported in large volume, the figures for factory consumption are taken as more indicative of the movement and they show the following comparisons:

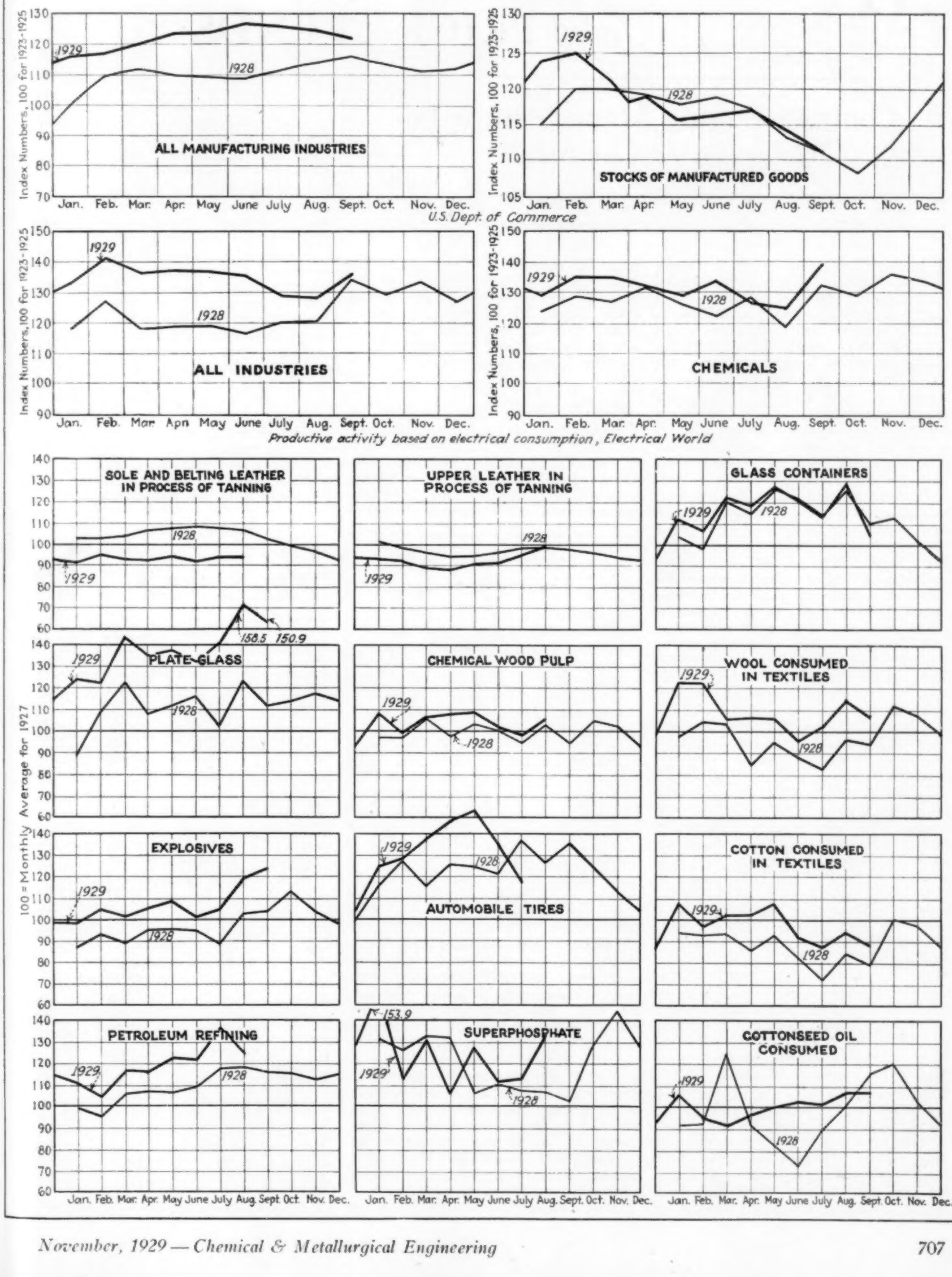
Factory Consumption of Vegetable Oils January-September, 1928-1929

	1929 1,000 lb.	1928 1,000 lb.
Cottonseed, crude	914,356	744,013
Cottonseed, refined	918,919	859,850
Corn, crude	114,879	93,657
Corn, refined	19,635	13,720
Cocoanut, crude	488,857	428,036
Cocoanut, refined	222,657	191,750
Peanut, crude	9,580	9,086
Peanut, refined	6,332	6,322
Soya bean, crude	16,008	12,133
Soya bean, refined	3,564	3,144
Olive, inedible	4,435	5,703
Sulphur	30,216	27,309
Palm kernel, crude	45,909	35,962
Palm kernel, refined	10,035	12,024
Rapeseed	10,303	11,530
Linseed	397,328	404,931
China wood	75,123	72,202
Castor	23,473	19,736
Palm	145,185	133,898

INDUSTRIAL production during September, after adjustments for seasonal conditions, showed a slight decline from the previous month, but was higher than a year ago, according to the weighted index of the Federal Reserve Board. The output of manufactures declined from August but was larger than a year ago. The production of minerals, on the other hand, showed gains over both periods. As compared with the previous month, manufacturing was smaller in industries producing iron and steel, textiles, automobiles, leather and shoes, while gains were registered in cement, non-ferrous metals, rubber tires, and tobacco products, if allowance is made for seasonal changes.

FOREIGN trade in chemicals and related products has held up very well. In September, exports of such commodities were valued at $12,441,989, as compared with $10,083,696 in September, 1928. The coal-tar group records a loss but this was due to the smaller amounts of benzol which were available for shipment. In the industrial chemical group, outward shipments for the month reached a valuation of $2,201,818 as against $1,800,725 a year ago. Sodium compounds were prominent in the export trade, with total shipments in September amounting to 53,058,172 lb., compared with 46,700,178 lb. a year ago. The loss in exports of borax was more than compensated by gains in shipments of silicate of soda, soda carbonates, sulphate of soda, and caustic soda. Paints, pigments, and varnishes also reported gains with mineral earth pigments holding a prominent position. White lead, which has fallen off this year as an export factor, regained some of its lost ground during the month.

ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES



MARKET CONDITIONS *and* PRICE TRENDS

Contract Buying Main Feature To Market for Chemicals

Various Selections Are Selling for Delivery Over All of 1930

DURING the last month producers of different chemicals announced sales prices for delivery over 1930. This included such important commodities as caustic soda, soda ash, and liquid chlorine. The alkalis show no price changes from the levels which prevailed for 1929 contracts. Liquid chlorine is offered at lower figures. Bichromates are unchanged from a year ago. As a result of the willingness of producers to accept long-term orders, buying interest was stimulated and an active trading period was experienced.

In the last week or so the situation was changed to some extent by the general depression brought about by the downward movement of the stock market. Some consumers who were prepared to take on new commitments held off with a view of awaiting developments. Spot trading also was subject to curtailment and a general disposition was shown to reduce, or at least not to increase, holdings of raw materials. This situation is expected to right itself as soon as securities become stabilized, and with few exceptions all lines of industry are looked to for a continuance of normal production and consumption.

BORAX interests have been interested in reports from abroad to the effect that shipments of borax from this country have been made to Trieste and then sent through Italy into France, and as Italian borax was admitted into that country at one-half the rate of duty it would be subjected to as an American product. Hence the charge has been made that such procedure was a subterfuge to defraud the French government. A short time ago the Chemical Division of the Bureau of Foreign and Domestic Commerce issued a report on borax in which foreign trade was touched upon. According to our government figures, exports of borax from this country to Italy in 1928 amounted to 1,826 tons against total exports of nearly 68,000 tons.

Another report from abroad which carried market significance was that French and German producers of caustic potash propose to renew their cartel contract which now extends to the end of the present year. Imported caustic potash is competing keenly in domestic markets and has forced the relatively low prices which are now prevailing. For the nine-month period ended Sept. 30, imports of caustic potash have reached a total of 11,526,776 lb. as compared with 8,681,797 lb. for the corresponding period of last year.

ADVICES from Chile state that the 70 oficinas in operation in September, 1929, produced 253,200 metric tons of nitrate of soda, compared with 259,400 tons during September of the previous year. Exports for September amounted to 252,000 metric tons, against 171,800 during the same month in 1928. World stocks at the end of September were given as 2,128,000 metric tons, against 1,643,700 at the end of September, 1928. Trading in domestic markets was quiet throughout the period with practically no change in quotations.

Announcement was made, effective as of Nov. 1, that importers of potash salts would extend prevailing prices to apply on all business transacted through April 30, 1930. This means that cost of potash for the fertilizer trade will be at unchanged levels for the spring season. The announcement also carries a guarantee against a price decline.

Other fertilizer chemicals are quiet at present. Fertilizer tag sales for October were reported as 28.6 per cent less than for October, 1928. For the three months ended October, however, they were 1.7 per cent larger than for the like period a year ago.

Salt cake is in a firm position as a result of smaller production and reduction in stocks held by producers.

Imports of salt cake for the first nine months of 1929 were 75,426 tons, which approaches three times the total imports for 1928, or 28,228 tons, and is at the rate of about 100,000 tons for the entire year. This reflects the continued growth in recent years in American imports of this commodity, from a figure of 1,913 tons in 1925 and 11,171 tons in 1927 to 75,426 tons for the nine months of this year. It is estimated that in 1927 the United States imports of German salt cake represented about 8 per cent of Germany's total exports, 20 per cent in 1928, and present figures indicate approximately 45 per cent for 1929.

German Potash Sales Decline Slightly

During the first nine months of 1929 the sale of pure potash by the German Potash Syndicate, amounting to 1,138,023 metric tons, showed little variance with the sales for the corresponding period of 1928. However, they were 13 per cent higher than the sales during the January-September, 1927, period. The figures follow:

	1928	1929
January	202,010	164,736
February	208,400	144,676
March	161,460	233,000
April	67,414	112,535
May	63,746	77,326
June	99,948	97,723
July	102,608	89,190
August	108,696	95,372
September	140,818	123,465
Total	1,155,100	1,138,023

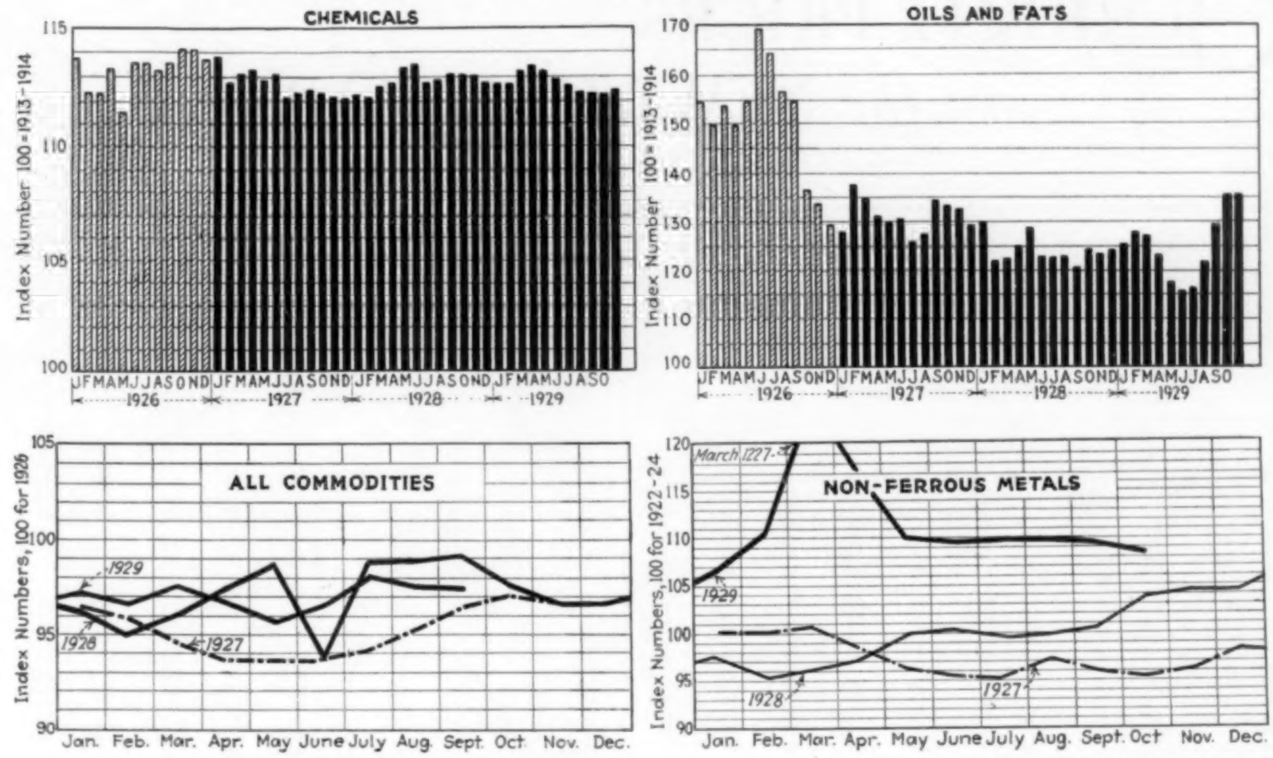
Exports of Chemicals

	September 1928	September 1929
Benzol, gal	3,011,489	724,944
Acid, sulphuric, lb.	581,760	516,264
Acid, boric, lb.	137,127	205,367
Other acids, lb	347,481	856,806
Methanol, gal	28,335	49,948
Glycerin, lb.	29,301	64,689
Acetone, lb.	299,833	233,686
Formaldehyde, lb.	193,565	144,972
Ammonium compounds, lb	128,866	181,016
Aluminum sulphate, lb.	3,624,277	4,381,194
Acetate of lime, lb.	448,539	....
Calcium carbide, lb.	69,862	102,146
Bleaching powder, lb.	1,385,355	359,273
Copper sulphate, lb.	180,439	223,900
Potassium compounds, lb.	331,854	260,273
Sodium bichromate, lb	435,912	403,500
Sodium cyanide, lb	122,867	121,441
Borax, lb.	12,884,466	7,816,648
Sodium carbonate, lb	5,569,120	7,535,975
Sodium silicate, lb.	5,406,672	6,351,863
Caustic soda, lb.	7,457,119	10,641,956
Other sodas, lb.	13,973,066	16,840,780
Sulphate of ammonia, ton	6,597	18,591
Sulphur, ton.	82,737	91,182
Potassium cyanide, lb.	701	18,847
Potassium carbonate, lb.	1,187,738	1,681,618
Caustic potash lb	1,040,388	1,144,261
Cream of tartar, lb	....	22,140
Potassium chlorate, lb	994,386	1,133,700
Sodium cyanide, lb	3,189,660	3,975,635
Sodium ferrocyanide, lb.	39,901	246,392
Sodium nitrite, lb	....	11,469
Sodium nitrate, ton	36,644	31,539
Sulphate of ammonia, ton	2,565	1,373

Imports of Chemicals

	September 1928	September 1929
Dead or creosote oil, gal	4,063,074	4,301,881
Coal-tar acids, lb.	104,492	115,072
Coal-tar intermediates, lb	146,387	133,594
Arsenic, white, lb.	1,569,391	2,562,459
Acid acetic, lb	....	2,954,207
Acid, formic, lb.	62,842	25,640
Acid oxalic, lb	72,292	121,256
Acid sulphuric, lb	3,162,883	825,402
Acid tartaric, lb.	244,256	219,529
Ammonium chloride, lb	819,904	1,144,188
Ammonium nitrate, lb	1,448,043	1,181,375
Barium compounds, lb	1,096,434	736,604
Calcium carbide, lb	375,500	134,000
Cobalt oxide, lb.	52,345	34,350
Copper sulphate, lb.	493,971	352,283
Bleaching powder, lb.	151,991	171,556
Glycerin, crude, lb.	359,069	971,204
Glycerin, ref., lb.	37,354	137,556
Iodine, lb.	74,530	....
Magnesium compounds, lb.	1,099,925	762,669

CHEM. & MET. *Weighted Indexes of* PRICES



U. S. Dept. of Labor — *Engineering & Mining Journal*

New Contracts Forecast Little Change in Chemical Prices

IF CONTRACT orders for next year's delivery may be taken as a basis, very little change in values for chemicals will be found in the coming year. The majority of business so far done in forward positions has been at unchanged levels. Liquid chlorine offers an exception, with the new contract figure favoring buyers. Borax and boric acid are higher, with producers of ammonia not yet on record.

Oxalic acid is well sold ahead and the scarcity of supplies for prompt shipment has created a situation which would warrant an appreciation of values. Furthermore, foreign markets are reported to have strengthened, which adds to the possibility of higher prices in domestic markets.

Metal salts are changing in price with unwonted frequency, especially those depending on a tin basis. In each case the price factor is found in the metal market, with future fluctuations subject to the same influence.

The question of demand is now being considered as of more than usual importance. The line of reasoning runs along lines that the financial situation will have a depressing effect on consumption and bring about a condition where selling pressure may easily arise. In view of the fact that enlarged productions have developed keen competition, which has kept sales prices close to producing costs, such an outcome is hardly logical. Furthermore, it remains to be seen to what extent demand for materials will decline. The majority of industries which are large consumers of chemicals are in a strong position and may prove immune to disturbances in the financial world.

Fertilizer chemicals are quiet at present with indications of a fairly steady price foundation. Potash salts are on a fixed schedule for the next six months. There is competition enough in nitrogen-bearing materials to hold prices from advancing and any changes would be more probable on the downward side.

Vegetable oils and fats changed to a marked degree during the month so far as values were concerned. Crude cottonseed oil, while not offered freely, has found no buyers except at low prices. Incidentally, recent estimates on the size of the cotton crop have indicated a larger yield than had been forecast a month ago. Lard has been a bearish factor and other fats have pursued a downward price course. Linseed oil has fluctuated considerably. Very high prices have been reached, but a good part of the rise was lost in later recessions. High prices cannot be well maintained without encouraging the use of substitutes. The Argentine flaxseed crop and the tariff question were of bullish influence some time ago, but the crop in South America now appears to have developed better than had been expected and the tariff influence appears to be more remote. Coconut oil has been in ample supply for some months and the same is true for palm oil and other oils of foreign origin. As a result they have been offered at low levels and have increased competition in such fields as admit of substituting one oil for another as is frequently done in the soap trade.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This month	**112.44**
Last month	112.32
November, 1928	113.08
November, 1927	112.02

Firm undertone is given by the fact that new contracts for mineral acids have been written above last year's levels. Salt cake is higher and lead salts also showed strength. Copper sulphate was lowered and tin salts are weak.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1913-14

This month	**128.22**
Last month	135.56
November, 1928	123.60
November, 1927	132.90

Lower prices were almost general during the period with declines in crude cottonseed oil, linseed oil, and tallow having the greatest effect in bringing down the index number.

CURRENT PRICES *in the* NEW YORK MARKET

For Chemicals, Oils and Allied Products

The following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Nov. 13.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.14 -$0.15	$0.14 -$0.15	$0.14 -$0.15
Acid, acetic, 28%, bbl., cwt.	3.88 - 4.03	3.88 - 4.03	3.62½- 3.87½
Boric, bbl, lb.	.06½- .06½	.05½- .06	.06½- .07
Citric, kegs, lb.	.46 - .47	.46 - .47	.46 - .47
Formic, bbl, lb.	.10½- .11	.10½- .11	.11 - .12
Gallic, tech., bbl., lb	.50 - .55	.50 - .55	.50 - .55
Hydrofluoric 30% carb, lb.	.06 - .07	.06 - .07	.06 - .07
Latic, 44%, tech., light, bbl., lb.	.11 - .11½	.11 - .11½	.12 - .12½
22%, tech., light, bbl., lb.	.05½- .06	.05½- .06	.05½- .06
Muriatic, 18°, tanks, cwt.	1.00 - 1.10	.85 - .90	.85 - .90
Nitric, 36°, carboys, lb.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.00 -20.00	18.00 -20.00	18.00- 20.00
Oxalic, crystals, bbl., lb.	.11 - .11½	.11 - .11½	.11 - .11½
Phosphoric, tech., c'bys., lb.	.08½- .09	.08½- .09	.08½- .09
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Tannic, tech., bbl., lb.	.35 - .40	.35 - .40	.35 - .40
Tartaric, powd., bbl., lb.	.38½- .39	.38½- .39	.38 - .39
Tungstic, bbl., lb.	1.30 - 1.40	1.30 - 1.40	1.00 - 1.20
Alcohol, ethyl, 190 p'f., bbl., gal.	2.68½- 2.71	2.68½- 2.71	2.68½- 2.71
Alcohol, Butyl, tanks, lb	.16½- .17	.16½- .17	.18½- .19
Denatured, 190 proof			
No. 1 special dr., gal	.51 -......	.51 -......	.47 -......
No. 5, 188 proof, dr., gal.	.51 -......	.51 -......	.47 -......
Alum, ammonia, lump, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Chrome, bbl., lb.	.05½- .05½	.05½- .05½	.05½- .06
Potash, lump, bbl., lb.	.03 - .03½	.03 - .03½	.02½- .03½
Aluminum sulphate, com., bags, cwt.	1.40 - 1.45	1.40 - 1.45	1.40 - 1.45
Iron free, bg., cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Aqua ammonia, 26°, drums., lb	.03 - .04	.03 - .04	.03 - .04
Ammonia, anhydrous, cyl., lb.	.14 -......	.14 -......	.13½-......
Ammonium carbonate, powd. tech., casks, lb	.12 - .13	.12 - .13	.12 - .13
Sulphate, wks., cwt.	2.10 -......	2.10 -......	2.35 -......
Amylacetate tech., drums, gal	1.75 - 2.00	1.75 - 2.00	1.75 - 2.00
Antimony Oxide, bbl., lb.	.09 - .10	.09 - .10	.09 - .10
Arsenic, white, powd., bbl., lb.	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs., lb	.09 - .10	.09 - .10	.09 - .10
Barium carbonate, bbl., ton	58.00 -60.00	58.00 -60.00	57.50 -60.00
Chloride, bbl., ton	63.00 -65.00	65.00 -67.00	63.00 -70.00
Nitrate, cask, lb.	.08 - .08½	.07½- .08	.08 - .08½
Blanc fixe, dry, bbl., lb.	.03½- .04	.03½- .04	.04 - .04½
Bleaching powder, f.o.b., wks., drums, cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, bbl., lb.	.03 - .03½	.02½- .03	.02½- .03
Bromine, cs., lb.	.45 - .47	.45 - .47	.45 - .47
Calcium acetate, bags., cwt.	4.50 -......	4.50 -......	4.00 -......
Arsenate, dr., lb	.07 - .08	.07 - .10	.06½- .07
Carbide drums, lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton.	20.00 -......	20.00 -......	20.00 -......
Phosphate, bbl., lb	.08 - .08½	.08 - .08½	.07 - .07½
Carbon bisulphide, drums, lb	.05 - .06	.05 - .06	.05 - .06
Tetrachloride drums, lb.	.06½- .07	.06½- .07	.06½- .07
Chlorine, liquid, tanks, wks., lb	.0285 - .04½	.03 - .03½	.03½- .04½
Cylinders	.04½- .06	.05 - .08	.05½- .08
Cobalt oxide, cans, lb.	2.10 - 2.20	2.10 - 2.20	2.10 - 2.25
Copperas, bgs., f.o.b. wks., ton	15.00 -16.00	15.00- 16.00	16.00 -17.00
Copper carbonate, bbl., lb	.22 - .23	.22 - .23	.17 - .18
Cyanide, tech., bbl., lb.	.49 - .50	.49 - .50	.49 - .50
Sulphate, bbl., cwt	5.50 - 6.00	6.00 - 6.10	5.30 - 5.50
Cream of tartar, bbl., lb.	.26½ .27	.26 - .26½	.27½- .28
Diethylene glycol, dr., lb	.10 - .15	.10 - .15	.10 - .15
Epsom salt, dom., tech., bbl., cwt.	1.75 - 2.15	1.75 - 2.00	1.75 - 2.00
Imp., tech., bags, cwt	1.15 - 1.25	1.15 - 1.25	1.15 - 1.25
Ethyl acetate, drums, bl	12 5 -......	12 5 -......	.83 -......
Formaldehyde, 40%, bbl., lb.	.08½- .09	.08½- .09	.08½- .09
Furfural, dr., lb.	.15 - .17½	.15 - .17½	.15 - .17
Fusel oil, crude, drums, gal	1.30 - 1.40	1.30 - 1.40	1.30 - 1.40
Refined, dr., gal.	1.90 - 2.00	1.90 - 2.00	2.50 - 3.00
Glaubers salt, bags, cwt.	1.10 - 1.20	1.10 - 1.20	1.00 - 1.10
Glycerine, c.p., drums, extra., lb.	.14 - .14½	.14 - .14½	.14 - .15
Lead:			
White, basic carbonate, dry casks, lb.	.09 -......	.09 -......	.08½-......
White, basic sulphate, sck., lb.	.08½-......	.08½-......	.07¾-......
Red, dry, sck., lb	.09½-......	.10 -......	.09¾-......
Lead acetate, white crys., bbl., lb.	.13 - .14	.14 - .14½	.13 - .13½
Lead arsenate, powd., bbl., lb.	.13 - .14	.13 - .14	.12 - .13
Lime, chem., bulk, ton	8.50 -......	8.50 -......	8.50 -......
Litharge, pwd., csk, lb	.08½-......	.09¾-......	.08¾-......
Lithopone, bags, lb.	.05½- .06	.05½- .06	.05½- .06½
Magnesium carb., tech., bags, lb.	.06 - .06½	.06 - .06½	.06½- .07
Methanol, 95%, tanks, gal	.55 -......	.55 -......	.55 -......
97%, tanks, gal.	.55 -......	.55 -......	.55 -......
Nickel salt, double, bbl., lb.	.13 - .13½	.13 - .13½	.10 - .11
Single, bbl., lb.	.13 - .13½	.13 - .13½	.10½- .11½

	Current Price	Last Month	Last Year
Orange mineral, csk., lb	$0.11½-......	$0.12½-......	$0.11½-......
Phosphorus, red, cases, lb	.55 - .57	.55 - .57	.62 - .65
Yellow, cases, lb.	.32 - .33	.32 - .34	.32 - .33
Potassium bichromate, casks, lb.	.09 - .09½	.09 - .09½	.09 - .09½
Carbonate, 80-85%, calc., csk., lb	.05½- .06	.05½- .06	.05½- .06
Chlorate, powd., lb.	.07½- .08½	.07½- .08½	.06½- .07
Cyanide, cs., lb	.52 - .55	.52 - .55	.51 - .53
F'rst sorts, csk., lb.	.08½- .09	.08½- .09	.08½- .09
Hydroxide (c'stic potash) dr., lb.	.06½- .06½	.07½- .07½	.07½- .07½
Muriate, 80% bgs., ton	36.75 -......	36.75 -......	36.40 -......
Nitrate, bbl., lb.	.06 - .06½	.06 - .06½	.06 - .07½
Permanganate, drums, lb.	.16 - .16½	.16 - .16½	.15 - .16
Prussiate, yellow, casks, lb	.18½- .19½	.18½- .19	.18 - .19
Sal ammoniac, white, casks, lb.	.046- .05	.046- .05	.047- .05
Salsoda, bbl., cwt.	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk, ton	22.00 -22.00	18.00 -20.00	14.00 -17.00
Soda ash, light, 58%, bags, contract, cwt.	1.32 -......	1.32 -......	1.32 -......
Dense, bags, cwt.	1.35 -......	1.35 -......	1.35 -......
Soda, caustic, 76%, solid, drums, contract, cwt.	2.90 - 3.00	2.90 - 3.00	3.00 - 3.10
Acetate, works, bbl., lb.	.06½- .07	.05 - .05½	.05½- .06
Bicarbonate, bbl., cwt.	2.00 - 2.25	2.00 - 2.25	2.00 - 2.25
Bichromate, casks, lb.	.07 - .07½	.07 - .07½	.07 - .07½
Bisulphate, bulk, ton.	15.00 -16.00	12.00 -15.00	3.00 - 3.50
Bisulphite, bbl., lb.	.03½- .04	.03½- .03½	.03½- .04
Chlorate, kegs, lb	.07½- .08	.07 - .07½	.06½- .06½
Chloride, tech., ton	12.00 -14.75	12.00- 14.75	12.00 -14.00
Cyanide, cases, dom., lb	.18 - .22	.18 - .22	.18 - .22
Fluoride, bbl., lb.	.08½- .09½	.08½- .09½	.08½- .09
Hyposulphite, bbl., lb	2.50 - 3.00	2.50 - 3.00	2.50 - 3.00
Nitrate, bags, cwt.	2.10 -......	2.10 -......	2.15 -......
Nitrate, casks, lb.	.07½- .08	.07½- .08	.07½- .08
Phosphate, dibasic, bbl., lb.	.03½- .03½	.03½- .03½	.03½- .03½
Prussiate, yel. drums, lb	.11½- .12	.11½- .12	.11½- .12
Silicate (30°, drums), cwt.	.75 - 1.15	.75 - 1.15	.75 - 1.15
Sulphide, fused, 60-62%, dr., lb.	.02½- .03½	.02½- .03	.03½- .04
Sulphite, cyrs., bbl., lb	.03 - .03½	.02½- .03	.02½- .03
Strontium nitrate, bbl., lb.	.09 - .09½	.09 - .09½	.09 - .09½
Sulphur, crude at mine, bulk, ton	18.00 -......	18.00 -......	18.00 -......
Chloride, dr., lb.	.04 - .05	.04 - .05	.04 - .05
Dioxide, cyl., lb.	.07 - .08	.09 - .10	.09 - .10
Flour, bag, cwt.	1.55 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin bichloride, bbl., lb.	.13½-......	.14½-......	.15½-......
Oxide, bbl., lb.	.44 -......	.46 -......	.53 -......
Crystals, bbl., lb	.33½-......	.35 -......	.37½-......
Zinc chloride, gran., bbl., lb	.06½- .06½	.06½- .06½	.06½- .06½
Carbonate, bbl., lb.	.10½- .11	.10 - .10½	.10 - .11
Cyanide, dr., lb.	.41 - .42	.40 - .41	.40 - .41
Dust, bbl., lb.	.09½- .10	.08½- .09	.09 - .10
Zinc oxide, lead free, bag, lb.	.06½-......	.06½-......	.06½-......
5% lead sulphate, bags, lb.	.06½-......	.06½-......	.06½-......
Sulphate, bbl., cwt.	3.00 - 3.25	2.75 - 3.00	2.75 - 3.00

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.12 -$0.12½	$0.13½-$0.14	$0.13½-$0.14
Chinawood oil, bbl., lb.	.14½-......	.15 -......	.14½-......
Coconut oil, Ceylon, tanks, N.Y., lb.	.07½-......	.07½-......	.08½-......
Corn oil crude, tanks, (f.o.b. mill), lb.	.07½-......	.08½-......	.08½-......
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.07½-......	.08½-......	.08½-......
Linseed oil, raw, car lots, bbl., lb.	.14.5-......	.158-......	.102-......
Palm, Lagos, casks, lb	.07 -......	.07½-......	.07½-......
Niger, casks, lb.	.06½-......	.07½-......	.07½-......
Palm Kernel, bbl., lb.	.07½-......	.08½-......	.09½-......
Peanut oil, crude, tanks (mill), lb.	.08½-......	.08½-......	.08½-......
Rapeseed oil, refined, bbl., gal.	.78 - .80	.80 - .82	.88 - .90
Soya bean tank (f.o.b. Coast), lb.	.10½-......	.09½-......	.09½-......
Sulphur (olive foots), bbl., lb.	.08½-......	.09 -......	.09½......
Cod, Newfoundland, bbl., gal.	.61 - .65	.65 - .67	.68 - .69
Menhaden, light pressed, bbl., gal.	.68 - .70	.68 - .70	.60 - .62
Crude, tanks (f.o.b. factory), gal.	.48 -......	.50 -......	.42½......
Whale, crude, tanks, gal	.80 -......	.80 -......	...... -
Grease, yellow, loose, lb.	.06½-......	.06½-......	.07½-......
Oleo stearine, lb.	.11½-......	.09½-......	.09½-......
Red oil, distilled, d.p. bbl., lb.	.10½- .11	.09½- .10	.09½- .09½
Tallow, extra, loose, lb	.07½-......	.07½-......	.08½-......

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb.	.80 - .85	.80 - .85	.85 - .90
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.35 - .36
Aniline oil, drums, extra, lb.	.14½- .15	.14½- .15	.15 - .16
Aniline salts, bbl., lb.	.24 - .25	.24 - .25	.24 - .25
Anthracene, 80%, drums, lb.	.60 - .65	.60 - .65	.60 - .65

Coal Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr., lb.	1.15 - 1.25	1.15 - 1.35	1.15 - 1.25
Benzidine base, bbl., lb.	.65 - .67	.67 - .70	.70 - .72
Benzoic acid, U.S.P., kgs, lb.	.51 - .60	.57 - .60	.58 - .60
Benzyl chloride, tech., dr., lb.	.25 - .26	.25 - .26	.25 - .26
Benzol, 90%, tanks, works, gal.	.23 - .25	.23 - .25	.22 - .23
Beta-naphthol, tech., drums, lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr., lb.	.14 - .17	.14 - .17	.18 - .20
Cresylic acid, 97%, dr., wks., gal.	.68 - .70	.70 - .72	.73 .75
Diethylaniline, dr., lb.	.55 - .58	.55 - .58	.58 - .60
Dinitrophenol, bbl., lb.	.30 - .32	.30 - .31	.31 - .35
Dinitrotoleun, bbl., lb.	.17 - .18	.17 - .18	.17 - .18
Dip oil, 25% dr., gal.	.26 - .28	.26 - .28	.28 - .30
Diphenylamine, bbl., lb.	.42 - .43	.42 - .43	.45 - .47
H-acid, bbl., lb.	.60 - .63	.60 - .63	.63 - .65
Naphthalene, flake, bbl., lb.	.04¾- .05	.04¾- .05	.05 - .06
Nitrobenzene, dr., lb.	.09 - .10	.09 - .10	.08½- .10
Para-nitraniline, bbl., lb.	.55 - .56	.55 - .56	.52 - .53
Para-nitrotoluine, bbl., lb.	.29 - .31	.29 - .31	.28 - .32
Phenol, U.S.P., drums, lb.	.13¾- .15	.13¾- .15	.15 - .17
Picric acid, bbl., lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., lb.	1.75 - 1.90	1.75 - 1.90	1.35 - 1.50
R-salt, bbl., lb.	.44 - .45	.44 - .45	.47 - .50
Resorcinal, tech., kegs, lb.	1.30 - 1.35	1.30 - 1.35	1.30 - 1.40
Salicylic acid, tech., bbl., lb.	.30 - .32	.30 - .32	.30 - .32
Solvent naphtha, w.w., tanks, gal.	.30 - .35	.30 -......	.35 -......
Tolidine, bbl., lb.	.86 - .90	.86 - .90	.95 - .96
Toluene, tanks, works, gal.	.45 -....	.45 -....	.35 -....
Xylene, com., tanks, gal.	.30 - .40	30 - .35	.36 - .40

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$23.00-$25.00	$23.00-$25.00	$23.00-$25.00
Casein, tech., bbl., lb.	.15½ .16	.15½- .16	.16½- .17
China clay, dom., f.o.b. mine, ton	10.00 -20.00	10.00 -20.00	10.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.08 - .13	.08 - .13	.06½- .07
Prussian blue, bbl., lb.	.35 - .36	.35 - .36	.31 - .32
Ultramine blue, bbl., lb.	.06 - .32	.06 - .32	.08 - .35
Chrome green, bbl., lb.	30 - .32	30 - .32	.27 - .30
Carmine red, tins, lb.	6 00 - 6 50	6 00 - 6 50	5.25 - 5 50
Para toner, lb.	75 - 80	.70 - 75	.70 - 80
Vermilion, English, bbl., lb.	1 90 - 2 00	1.90 - 2 00	1.80 - 1.85
Chrome yellow, C. P., bbl.; lb.	17 - .17½	17 - .17½	.15½- .16
Feldspar, No. 1 (f.o.b. N.C.), ton	6 50 - 7.50	6 50 - 7.50	5.75 - 7.00
Graphite, Ceylon, lump, bbl., lb.	.07¾- .08½	.07¾- .08½	.08 - .09
Cum copal Congo, bags, lb.	.07¾- .08	.07¾- .08	.07¾- .08
Manila, bags, lb.	.16 - .17	.16 - .17	.15 - 18
Damar, Batavia, cases, lb.	.24 - .25	.24 - .25	.22 - .23
Kauri No. 1 cases, lb.	.48 - .53	.48 - .53	.48 - .53
Kieselguhr (f.o.b. N. Y.), lb.	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton	40.00 -......	40.00 -......	40.00 -......
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	03 - .40	03 - .40	.03 - .35
Rosin, H., bbl.	8.75 -......	9.40 -......	9 55 -......
Turpentine, gal.	.52½-......	.56½-......	.53½-......
Shellac, orange, fine, bags, lb.	.60 -......	.61 -......	.61 - .52
Bleached, bonedry, bags, lb.	.52 - .54	.56 - .58	.60 - .66
T. N. bags, lb.	39 - .40	.43 - .44	.47 - .48
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10.00 -12.00	10 00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton	9.50 -......	9.50 -......	10.50 -......
300 mesh (f.o.b. Ga.), ton	7.50 -10.00	7 50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton	13 75 -	13 75 - ...	13 75 - 1

	Current Price	Last Month	Last Year
Wax, Bayberry, bbl., lb.	$0.28 -$0.30	$0 28 -$0.31	$0.30 -$0.32
Beeswax, ref., light, lb.	.38 - .39	.38 - .40	.41 - .42
Candelilla, bags, lb.	.22 - .23	.22 - .23	.23 - .24
Carnauba, No. 1, bags, lb.	.33 - .34	.33 - .34	.50 - .51
Paraffine, crude 105-110 m.p., lb.	.04½- 05	04½- .05	.04½- .05

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton	$200.00-.....	$200.00-.....	$200.00-.....
Ferromanganese, 78-82%, ton	105 00-.....	105 00-.....	105 00-.....
Spiegeleisen, 19-21%, ton	33 00-.....	33.00-.....	32.00-.....
Ferrosilicon, 14-17%, ton	45 00-.....	45.00-.....	45.00-.....
Ferrotungsten, 70-80%, lb.	1.45	1.45-.....	1 35- .98
Ferro-uranium, 35-50%, lb.	4.50-....	4.50-....	4.50-....
Ferrovanadium, 30-40%, lb.	3.15- 3.75	3.15- 3.75	3.15- 3.75

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic, lb.	$0.18 -.....	$0.18 -.....	$0.15½-.....
Aluminum, 96-99%, lb.	.24 - .30	.24 - .26	.24 - .25
Antimony, Chin. and Jap., lb.	.08½-......	.08½-......	.09½-......
Nickel, 99%, lb.	.35 -.....	.35 -.....	.35 -.....
Monel metal, blocks, lb.	.28 -......	.28 - .28	.28 -......
Tin, 5-ton lots, Straits, lb.	.39½-......	42¾-......	.49 -......
Lead, New York, spot, lb.	.0625-....	069 -.....	.065 -.....
Zinc, New York, spot, lb.	.0655-......	.0715 -.....	.066 -.....
Silver, commercial, oz.	.49¾-....	50¾-....	.58½-....
Cadmium, lb.	.85 - .95	.85 - .95	.70 - .80
Bismuth, ton lots, lb.	1.70 -.....	1 70 -.....	1.70 -.....
Cobalt, lb.	2.10 - 2.50	2.10 - 2.50	2 50 -......
Magnesium, ingots, 99%, lb.	.85 - 1.10	85 - 1.10	85 - 1.10
Platinum, ref., oz.	65 00- 66.00	65.00- 66.00	76.00-76.50
Palladium ref., oz.	38 00- 40.00	38.00- 40.00	42.00-46.00
Mercury, flask, 75 lb.	124.50-......	124.50-	128 00-.....
Tungsten powder, lb.	1.35- 1 50	1.35- 1.50	1.10- 1.15

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks., ton	$7.50- $8.00	$7.50- $8.50	$5.50- $8.75
Chrome ore, c.f. post, ton	22.00- 25.00	22.00- 24.00	22.00- 23.00
Coke, fdry., f.o.b. ovens, ton	2 85- 3 00	2.85- 3.00	2.85- 3.00
Fluorspar, gravel, f.o.b. Ill., ton	18 00- 20.00	18.00- 20.00	17.00-18.00
Ilmenite, 52% TiO_2, Va., lb.	9 50- 11.00	.00¾- .00¾	.00¾-......
Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit	.31 - .36	.34 - .37	.36 - .38
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y., lb.	.48 - .50	.48 - .50	.48- .50
Monazite, 6% of ThO_2, ton	80.00-......	80.00-......	130.00-......
Pyrites, Span. fines, c.i.f., unit	.13 -......	.13 -......	.13 -......
Rutile, 94-96% TiO_2, lb.	.10 - .11	.11 - .13	.11 - .13
Tungsten, scheelite, 60% WO_3 and over, unit	16.00- 17.00	15.00 -.....	11.25 -11.50
Vanadium ore, per lb. V_2O_5, lb.	40.00- 45.00	.28 -......	nom. - nom.
Zircon, 99%, lb.	03 -	03 -	03 -

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

Acetylene Plant—Prest-O-Lite Co., 30 East 42nd St., New York, N. Y., is having plans prepared for the construction of a 1 story, 55 x 134 ft. acetylene plant at Jacksonville, Fla. Estimated cost $45,000.

Acetylene Plant—Willard Storage Battery Co., c/o P. N. Voth, Construction Manager, 246 East 131st St., Cleveland, O., awarded contract for a 1 story, 23 x 40 ft. acetylene plant to Albert M. Higley Co., Plymouth Bldg., Cleveland. Estimated cost $40,000.

Acid-Proof Chemical Stoneware Factory — U. S. Stoneware Co., F. S. Wills, Pres., 50 Church St., New York, N. Y., acquired a 5 acre site adjoining plant No. 3 at Tallmadge, O., to provide for expansion, for the manufacture of acid-proof chemical stoneware.

Alcohol Plant—Petroleum Chemical Co., Barnsdall, Okla., is having preliminary plans prepared for the construction of an alcohol plant. Estimated cost $40,000. Private plans.

Alloy Plant — Aluminum Co. of America, Oliver Bldg., Pittsburgh, Pa., awarded contract for structural steel for an alloy plant at Alcoa, Tenn. Estimated cost $2,000,000.

Aluminum Products Factory—U. S .Aluminum Co., 3311 Dunn Rd., Detroit, Mich., will soon award contract for the construction of a 1 story, 100 x 380 ft. factory for the manufacture of aluminum products. Estimated cost $75,000. Private plans.

Aluminum and Brass Factory—United Brass & Aluminum Co., Goulden Ave., Port Huron, Mich., plans the construction of a 1 story, 50 x 300 ft. factory. Estimated cost $45,000. G. L. Harvey, Federal Commercial Bank, Port Huron, Mich., is architect. Equipment for manufacture of brass and aluminum products will be required.

Asbestos Products Factory — Johns-Manville Corp., 41st St. and Madison Ave., New York, N. Y., awarded contract for addition to asbestos products factory at Manville, N. J., to Wigton Abbott Corp., 552 West 23rd St., New York, N. Y. Estimated cost $300,000.

Carbon Factory—National Carbon Co., West 117th St. and Madison Ave., Cleveland, O., M. Fraser, Purch. Agt., had plans prepared for the construction of a 1 story, 22 x 118 ft. addition to factory on West 76th St. Estimated cost $40,000. Private plans.

Carbon Black Plant—Taylor Link Oil Co., San Angelo National Bank, San Angelo, Tex., is having preliminary surveys made for the construction of a carbon black plant at Bakersfield. Estimated cost $100,000. Private plans.

Carbonic Gas, etc. — Liquid Carbonic Corp., 4238 24th St., Detroit, Mich., awarded contract for the construction of a 1 story, 46 x 125 ft. factory for the manufacture of carbonic gas and bottlers' supplies to Cooper Little Co., 5057 Woodward Ave., Detroit. Estimated cost $40,000.

Carbonizing and Briquetting Plant—Wyoming Carbonizing & Briquetting Corp., c/o C. Peter, Managing Dir., Newhouse Bldg., Salt Lake City, Utah, is having plans prepared for the construction of a plant 1,000 ton capacity at Conroy, Wyo. Estimated cost $1,500,000. K. A. Loven, Buckingham Hotel, Minneapolis, Minn., is engineer.

Cement Plant—Atlas Portland Cement Co., 25 Broadway, New York, N. Y., plans the construction of a cement plant at Havana, Cuba. Owner may supply detail if addressed by letter. Address president's office.

Cement Plant—E. J. Kraus, Tulsa, Okla., having surveys made by F. L. Smith & Co., 225 Broadway, New York, N. Y., Engrs., for the construction of a portland cement plant at Tulsa. Estimated cost $1,000,000.

Cement Plants — Union Soviet Socialist Republic awarded contract for the construction of four cement plants to MacDonald Engineering Co., 50 West Jackson Ave., Chicago, Ill.

Chemical Plant — American I. G. Chemical Corp., c/o National City Co., 55 Wall St., New York, N. Y., plans the construction of a chemical plant south of Monroe, La.

Chemical Plant—American-La France Foamite Corp., 250 West 57th St., New York, N. Y., awarded contract for a 1 story experimental plant at Caton Ave. and Main St., Elmira, to Lowman Construction Co., 312 Railroad Ave., Elmira. Estimated cost $50,000.

Chemical Testing, etc.—Edgewater Steel Co., W. A. McKean, Purch. Agt., Oakmont, Pa., will soon award contract for a 2 story storage, manufacturing and chemical testing plant. Private plans. New chemical equipment will be required.

Chemical Factory—Dewey & Almy Chemical Co., c/o H. L. Kennedy Co., 80 Boylston St., Boston, Mass., Archt., will build a 4 story additional unit to chemical plant on Harvey St., Cambridge. Estimated cost $40,000. Work will be done by separate contracts.

Chemical Plant—Plough Chemical Co., 121 South Second St., Memphis, Tenn., received lowest bid for the construction of a chemical plant from National Construction Co., Glen Bldg., Atlanta and S. & W. Construction Co., Shrine Bldg., Memphis. $700,000.

Chemical Plant Addition—Wallace & Tiernan, Belleville, N. J., plans addition to chemical plant at Main and Mill Sts. Estimated cost $150,000. Private plans.

Chemical Plant—Carlova Inc., 200 5th Ave., New York, N. Y., plans alteration and adoption of building at Memphis, Tenn., for the manufacture of perfumes and cosmetics at 62 West Iowa St. Estimated cost to exceed $40,000. Maturity after Nov. 15.

Cosmetic Factory—M. Factor, 326 South Hill St., Los Angeles, Calif., awarded contract for a 4 story, 56 x 115 ft., factory at 914 North Mansfield Ave. to Miller & Miller, 4853 West Washington St., Los Angeles. Estimated cost $150,000.

Clay Products Plant—Lawrence County Clay Products Co., Ironton, O., plans the construction of a 1 story factory for the manufacture of clay products. Estimated cost $40,000 to $50,000. Private plans. New machinery and equipment will be required.

Coke Oven Plant—Hamilton By-Product Coke Oven Co., A. L. Leavitt, Pres., 4 Hughson St. S., Hamilton, Ont., plans to take over citys artificial gas plant and erect and equip coke oven plant at St. Thomas to cost $150,000. Private plans.

Creosoting Plant—Brown Wood Preserving Co., organizing, subsidiary of W. P. Brown & Sons Lumber Co., 2531 South 4th St., Louisville, Ky., acquired a 93 acre site and plans the construction of a creosoting plant on Ashbottom Rd. Estimated cost $2,500,000.

Electric Furnace Factory—Hoskins Mfg. Co., 4435 Lawton Ave., Detroit, Mich., awarded contract for a 1 story addition to factory for the manufacture of electric furnaces to Hazleton-Clark Co., 1038 Michigan Theatre Bldg., Detroit. Estimated cost $40,000. Miscellaneous equipment will be required.

Enameling Plant—Electric Belle Range Co., Huntsville, Ala., awarded contract for the construction of a 2 story, 52 x 144 ft. enameling plant to G. A. Rogers, Huntsville. Estimated cost $25,000.

Gas Plant — Cape Cod Gas Co., 1 State St., Boston, Mass., is having plans prepared for the construction of an illuminating gas plant at Hyannis to furnish gas for towns of Hyannis, Barnstable, Yarmouth, Dennis, Harwich and Chatham. Estimated cost $750,000. S. B. Gallagher, 20 Hammatt St., Ipswich, is engineer.

Gas Plant—Buzzards Bay Gas Co., 1 State St., Boston, Mass., is having preliminary plans prepared for the construction of an illuminating gas plant at Bourne to supply gas in Bourne, Falmouth and Wareham. Estimated cost $500,000. S. B. Gallagher, 20 Hammatt St., Ipswich, is engineer.

Gas Plant—Wallingford Gas Light Co., 210 Center St., Wallingford, Conn., awarded contract for the construction of a water gas plant on North Washington St., to Western Construction Co., Fort Wayne, Ind. Estimated cost $42,500.

Gasoline Plant—Midland Gasoline Co., Midland, Tex., plans the construction of a four unit gasoline plant in Eastland Pool District near Coleman. Estimated cost $150,000. Private plans.

Glass Plant—DuPont Viscoloid Co., 51 Lancaster St., Leominster, Mass., c/o R. W. Brooks, Arlington, N. J., awarded contract for the construction of a plant for the manufacture of glass at Leominster to Wiley & Foss, 215 Central St., Fitchburg. Estimated cost $1,000,000.

Gypsum Factory — U. S. Gypsum Co., 56th and Grays Ferry Rd., Philadelphia, Pa., awarded contract for a 1 story, 60 x 160 ft. factory to Morton C. Tuttle Co., 56th St. and Grays Ferry Rd., Philadelphia. Estimated cost $80,000.

Factory—Minerals Increment Co., J. R. McInerny, Pres., 1400 East 6th St., Los Angeles, Calif., plans the construction of first unit of factory for the manufacture of "lighter-than-air" steel under a German patent at Pittsburg, Calif. Estimated cost to exceed $100,000.

Laboratory (Research) — Dept. of Public Works, Ottawa, Ont., will receive bids until Dec. 3 for the construction of a 4 story, 150 x 420 ft. national research laboratory on Sussex St. Estimated cost $2,500,000. T. W. Fuller, c/o owner, is architect. Power to be used in new building will be developed from Rideau Falls which are on the site.

Lead Factory—National Lead Co., 111 Broadway, New York, N. Y., plans the construction of first unit of factory at Los Angeles, Calif. Estimated cost $250,000.

Linoleum Factory—Berry, Ostlere & Shepherd, Kirkcaldy, Scotland, is having plans prepared for the construction of a plant for the manufacture of linoleum at Farnham, Que. Estimated cost $2,000,000. I. M. Robertson, 1017 Keefer Bldg., Montreal, Que., is architect.

Paint Factory—Pittsburgh Plate Glass Co., 205 Pittsburgh Ave., Milwaukee, Wis., is having preliminary plans prepared for the construction of a 5 story paint factory on Barclay St. Estimated cost $1,000,000. Private plans.

Paint Factory—Rinshed-Mason Co., 5935 Milford Ave., Detroit, Mich., awarded contract for a 1 story addition to factory for manufacture of industrial paints on Milford Ave., to Rutherford-Sickler Co., 415 Brainard St., Detroit. Estimated cost $50,000. Equipment for grinding and mixing paints will be required.

Paint Manufacturing Plant — Ra Var Corp., New Haven, Conn., will build by separate contracts, a 2 story, 80 x 120 ft. paint manufacturing plant at 46-58 Albert Ave. Estimated cost $70,000. Austin Co., 326 Frelinghuysen Ave., Newark, N. J., is architect.

Paper Plant—Fort Howard Paper Co., Green Bay, Wis., awarded contract for the construction of a 3 story, 100 x 200 ft. warehouse and paper converting building, etc., in connection with plant, to Selmer Co., Green Bay.

Paper Mill—Powell River Co. Ltd., Powell River, B. C., is having plans prepared for the construction of a 32,000 hp. hydro electric power plant and dam, etc., on Lois River, and additional paper machine and buildings to add 35,000 tons per year to present output. Estimated cost $8,000,000. P. Sandwell, c/o owners, is resident engineer.

Paperboard Mill—Canadian Paperboard Co., 2 Seigneurs St., Montreal, Que., awarded general contract for a 1 story, 108 x 162 ft. addition to paperboard mill to Stevens Engineering Co., 25 St. Patrick St., Toronto. Estimated cost $100,000.

Pigment Plant—Commercial Pigment Co., 230 Park Ave., New York, N. Y., has work under way on addition to plant for the manufacture of chemicals, pigments, paints, etc. at Baltimore, Md. Estimated cost $40,000. Contract awarded to C. W. Schmidt, Hearst Tower Bldg., Baltimore.

Radio Tube Factory—Sonatron Tube Co., 57 State St., Newark, N. J., will receive bids about Nov. 15, for the construction of a 6 story, 68 x 120 ft. radio tube factory at 78-82 8th Ave. Estimated cost $175,000. Siegler & Greenberg, 164 Market St., Newark, are architects.

Filter House — Continental Refining Co., Reuseville Rd., Oil City, Pa., plans to rebuild filter house destroyed by fire. Estimated cost including equipment $150,000. Architect not selected. Will mature in about one year.

Retort Building — Vicking Oil Co., G. H. Seager, Clarendon, Pa., awarded contract for a 1 story, 46 x 66 ft. retort building in Warren Co., to Truscon Steel Co., Albert St. Ext., Youngstown, O.

Refinery (Oil)—Atlantic Refining Co., 260 South Broad St., Philadelphia, Pa., plans the construction of an oil refinery and distribution station, etc., at New Haven, Conn. Estimated cost $500,000 and $1,000,000 respectively.

Refinery (Oil) Anderson—Pritchard Oil Corp., Colcord Bldg., Oklahoma City, Okla., is having preliminary plans prepared for the construction of an oil refinery. Estimated cost $100,000. Private plans.

Refinery (Oil)—Mexican Petroleum Co. Ltd., subsidiary of Pan American Petroleum & Transport Co., 122 East 42nd St., New York, N. Y., will build an oil refinery at Savannah, Ga. Estimated cost $1,000,000. Private plans. Work will be done by day labor.

Refinery (Oil and Gas)—Indiana Oil & Gas Co., subsidiary of Grayburg Oil Co., J. W. Choate, Grayburg Bldg., San Antonio, Tex., is having plans prepared for the construction of an oil and gas refinery. Estimated cost $1,000,000. Hope Engineering Co., 149 Broadway, New York, N. Y., is engineer. Complete machinery and equipment will be required.

Rubber Factory—Tuscan Rubber Co., Carrollton, O., plans the construction of a 1 story factory for the manufacture of rubber gloves. Estimated cost $40,000. Private plans.

Rubber Factory — U. S. Rubber Co., 211 Passaic St., Passaic, N. J., awarded contract for a 5 story, 110 x 425 ft. factory at Market and South Sts. to Turner Construction Co., 420 Lexington Ave., New York, N. Y. Estimated cost $1,000,000.

Ruberoid Plant Unit—Ruberoid Co., G. F. Leir, Millis, Mass., awarded contract for a 1 story, 120 x 190 ft. additional unit to plant to Eastern Construction Co., 335 North Main St., Woonsocket, R. I.

Shoe Vulcanizing Building—Hood Rubber Co., 98 Nichols Ave., Watertown, Mass., will soon award contract for the construction of a 2 story shoe vulcanizing building on Nichols Ave. Estimated cost $40,000 to $50,000. Private plans.

Sulphuric Acid Plant Addition—Ozark Chemical Co., Ritz Bldg., Tulsa, Okla., is building a contact acid unit as addition to sulphuric acid plant. Estimated cost $200,000. Equipment contracts let.

Refinery (Sugar)—American Beet Sugar Co., c/o F. Kaspar, Rocky Ford, Colo., plans the construction of a large beet sugar refinery in San Luis Valley in 1930.

Sugar Mill—H. B. Minor, Tampico, Mexico, Vice Consul reports that a group of large land owners will construct sugar mill at Villa Kaurex in the vicinity of Xiococencatl, Tamaulipas, Mexico. Estimated cost $2,400,000.

Silicate of Soda Plant—Philadelphia Quartz Co., 121 South Third St., Philadelphia, Pa., acquired a 4 acre site and plans the construction of a plant for production of silicate of soda in its various forms, at Baltimore, Md. Architect and engineer not selected.

Silos and Packroom—West Pennsylvania Cement Co., West Winfield, Pa., awarded contract for additional silos for cement storage and new pack room increasing storage capacity 210,000 bbl. to McDonald Spencer Engineering Co., 420 Lexington Ave., New York, N. Y. Estimated cost $160,000.

INDUSTRIAL NOTES

YARNALL-WARING COMPANY, Philadelphia, has appointed R. A. Martin successor to S. D. Barr who resigned as Southeastern representative at Atlanta, Ga.

HOMESTEAD VALVE MANUFACTURING COMPANY, Coraopolis, Pa., has placed C. E. Ruth in charge of sales in the eastern Lakes district.

DESPATCH OVEN COMPANY, Minneapolis, has appointed Industrial and Combustion Engineering Corporation, Birmingham, as district engineers for Alabama, Georgia, Mississippi and Tennessee.

PALMER-BEE COMPANY, Detroit, is now represented in the Pittsburgh district by G. M. Demarest.

JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, has purchased the Bakstad Crusher & Equipment Corp., Chicago, and is retaining the personnel of its new subsidiary.

GENERAL REFRACTORIES COMPANY, Philadelphia, has appointed Desch Supply & Equipment Company, Baltimore, as representatives for Maryland and the Harris Pump and Supply Company, Pittsburgh, for the Western Pennsylvania District.

H. K. FERGUSON COMPANY, Cleveland, has promoted W. R. Eberhardt, for 10 years engineer for the company, to manager of the New York office.

GEARS & FORGINGS, INC., has moved its Chicago office to the newly-acquired plant at 2108 North Natchez Ave.

COMBUSTION ENGINEERING CORPORATION has opened an office at 1411 Fourth Avenue, Seattle, Wash., in charge of G. M. Bechtel.

ALLIS-CHALMERS MFG. COMPANY, Milwaukee, has chosen A. D. Brown to succeed M. W. Phelps, who has resigned as district manager at Buffalo, N. Y.

CHAIN BELT COMPANY, Milwaukee, has opened a New England office at Park Square Building, Boston, with J. K. Merwin in charge.

MIDVALE COMPANY, Nicetown, Pa., announces the purchase of Chrome Alloy Products, Inc., of Conshohocken, Pa., for the manufacture of chrome and chrome-nickel castings.

MACDONALD BROTHERS ENGINEERING LABORATORIES will be opened shortly at Detroit, Mich., endorsed by Kidder, Peabody & Company, Boston, where it will provide a centralized laboratory and exhibit for industrial equipment in actual operation. The engineering staff will assist exhibitor representatives and prepare certified cost and performance studies.

CUTLER-HAMMER, INC., has moved its St. Louis office to 1914 Washington Ave. and has additionally established a warehouse in that district.

INDUSTRIAL CHEMICAL SALES COMPANY, INC., New York, will handle the filtering materials of the Floatstone Products Company, Los Angeles, Calif.

MIXING EQUIPMENT COMPANY has removed to 1024 Garson Ave., Rochester, N. Y., but will continue a New York office at 229 East 38th St.

WAGNER ELECTRIC CORPORATION, St. Louis, has moved its Milwaukee office to 525 Broadway and its St. Louis office to 909 Plaza Olive Building. Its new Iowa representative, at Des Moines, Iowa, is D. O. Reardon.

ZAREMBA COMPANY, Buffalo, N. Y., is represented in its new Chicago office at 205 West Wacker Drive by F. F. Mackentepe, who has spent many years in the sale of chemical equipment.